# TFT LCD Tentative Specification

# MODEL NO.: V420H2 – LE4

Customer: _____

Approved by: _____

Note:

| | |
|---|---|
| Approved By | TV Head Division |
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# - CONTENTS -

REVISION HISTORY ---------- 3

1. GENERAL DESCRIPTION ---------- 4
   1.1 OVERVIEW
   1.2 FEATURES
   1.3 APPLICATION
   1.4 GENERAL SPECIFICATIONS
   1.5 MECHANICAL SPECIFICATIONS

2. ABSOLUTE MAXIMUM RATINGS ---------- 5
   2.1 ABSOLUTE RATINGS OF ENVIRONMENT
   2.2PACKAGE STORAGE
   2.3ELECTRICAL ABSOLUTE RATINGS
      2.3.1 TFT LCD MODULE
      2.3.2 BACKLIGHT UNIT

3. ELECTRICAL CHARACTERISTICS ---------- 7
   3.1 TFT LCD MODULE
   3.2 BACKLIGHT CONVERTER UNIT
      3.2.1 LED LIGHT BARCHARACTERISTICS
      3.2.2 CONVERTER CHARACTERISTICS
      3.2.3 CONVERTER INTERFACE CHARACTERISTICS

4. BLOCK DIAGRAM ---------- 13
   4.1 TFT LCD MODULE

5. INTERFACE PIN CONNECTION ---------- 14
   5.1 TFT LCD MODULE
   5.2 BACKLIGHT UNIT
   5.3 CONVERTER UNIT
   5.4 BLOCK DIAGRAM OF INTERFACE
   5.5 LVDS INTERFACE
   5.6 COLOR DATA INPUT ASSIGNMENT

6. INTERFACE TIMING ---------- 25
   6.1 INPUT SIGNAL TIMING SPECIFICATIONS
   6.2 POWER ON/OFF SEQUENCE

7. OPTICAL CHARACTERISTICS ---------- 28
   7.1 TEST CONDITIONS
   7.2 OPTICAL SPECIFICATIONS

8. DEFINITION OF LABELS ---------- 32
   8.1 CMO MODULE LABEL

9. PACKAGING ---------- 33
   9.1 PACKING SPECIFICATIONS
   9.2 PACKING METHOD

10. PRECAUTIONS ---------- 35
   10.1 ASSEMBLY AND HANDLING PRECAUTIONS
   10.2 SAFETY PRECAUTIONS

11. MECHANICAL CHARACTERISTICS ---------- 36

## REVISION HISTORY

| Version | Date | Page (New) | Section | Description |
|---|---|---|---|---|
| Ver 0.0 | Mar 11,10' | All | All | Tentative Specification was first issued. |
| Ver 0.1 | Mar 25,10' | 10 | 3.2 | Backlight Converter Unit |
| Ver 0.1 | Mar 25,10' | 29 | 7.2 | Optical Specifications |

# 1. GENERAL DESCRIPTION

## 1.1 OVERVIEW

V420H2- LE4 is a 42" TFT Liquid Crystal Display module with LED Backlight and 2 ch-LVDS interface. This module supports 1920 x 1080 Full HDTV format and can display 16.7M colors ( 8-bit ). The converter module for backlight is built-in.

## 1.2 FEATURES

-High brightness (450 nits)

- Ultra-high contrast ratio (6000:1)
- Faster response time (gray to gray average 4.5 ms) (5.5ms)
- High color saturation NTSC 72% (70%)
- Ultra wide viewing angle : 176(H)/176(V) (CR≥20) with Super MVA technology
- DE (Data Enable) only mode
- LVDS (Low Voltage Differential Signaling) interface

## 1.3 APPLICATION

- TFT LCD TVs
- Multi-Media Display

## 1.4 GENERAL SPECIFICATI0NS

| Item | Specification | Unit | Note |
|---|---|---|---|
| Active Area | 930.24 (H) x 523.26 (V) (42" diagonal) | mm | (1) |
| Bezel Opening Area | 937.24 (H) x 530.26 (V) | mm | |
| Driver Element | a-si TFT active matrix | - | |
| Pixel Number | 1920 x R.G.B. x 1080 | pixel | |
| Pixel Pitch (Sub Pixel) | 0.1615 (H) x 0.4845 (V) | mm | |
| Pixel Arrangement | RGB vertical stripe | - | |
| Display Colors | 1.07G | color | |
| Display Operation Mode | Transmissive mode / Normally Black | - | |
| Surface Treatment | Anti-Glare Coating (Haze 11%)<br>Hard Coating (3H) | - | |

## 1.5 MECHANICAL SPECIFICATIONS

| Item | | Min. | Typ. | Max. | Unit | Note |
|---|---|---|---|---|---|---|
| Module Size | Horizontal(H) | - | 973.24 | - | mm | (1) |
| | Vertical(V) | - | 566.26 | - | mm | (1) |
| | Depth(D) | - | 10.8 | - | mm | |
| | Depth(D) | 24.6 | 25.6 | 26.6 | mm | To converter cover |
| Weight | | | 7950 | | | |

Note (1) Please refer to the attached drawings for more information of front and back outline dimensions.

## 2. ABSOLUTE MAXIMUM RATINGS

### 2.1 ABSOLUTE RATINGS OF ENVIRONMENT

| Item | Symbol | Value | | Unit | Note |
|---|---|---|---|---|---|
| | | Min. | Max. | | |
| Storage Temperature | $T_{ST}$ | -20 | +60 | ºC | (1) |
| Operating Ambient Temperature | $T_{OP}$ | 0 | +50 | ºC | (1), (2) |
| Shock (Non-Operating) | $S_{NOP}$ | - | 35 | G | (3), (5) |
| Vibration (Non-Operating) | $V_{NOP}$ | - | 1.0 | G | (4), (5) |

Note (1) Temperature and relative humidity range is shown in the figure below.

(a) 90 %RH Max. (Ta ≦ 40 ºC).

(b) Wet-bulb temperature should be 39 ºC Max. (Ta > 40 ºC).

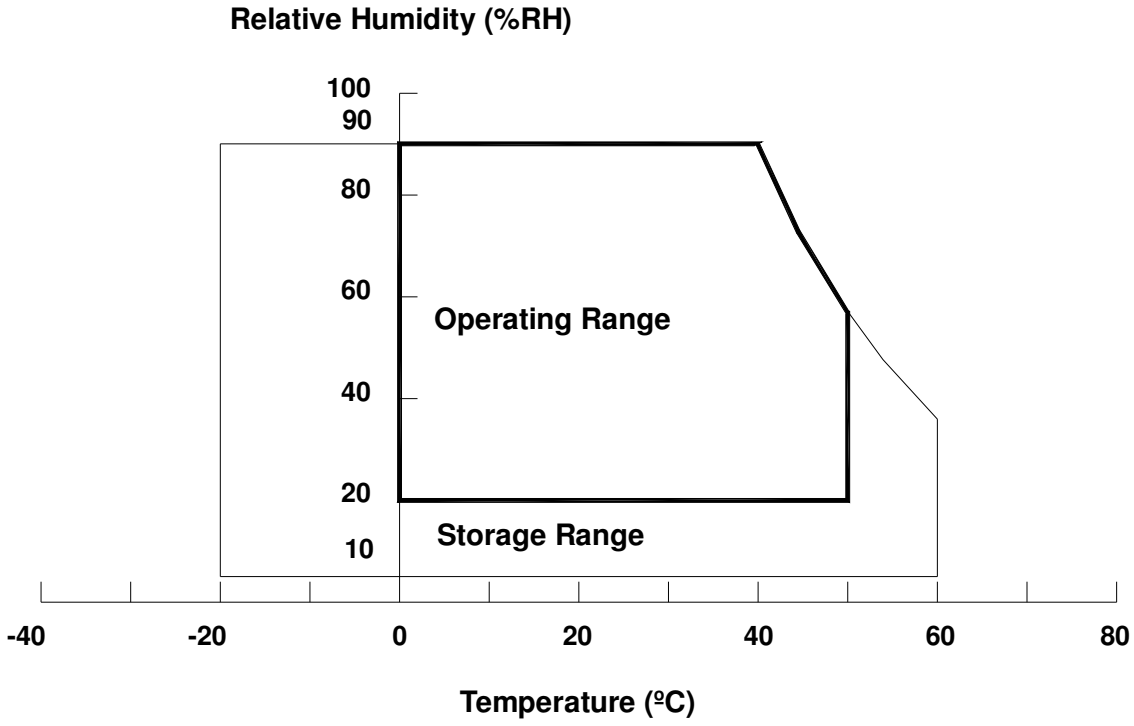
(c) No condensation.

Note (2) The maximum operating temperature is based on the test condition that the surface temperature of display area is less than or equal to 65 ºC with LCD module alone in a temperature controlled chamber. Thermal management should be considered in final product design to prevent the surface temperature of display area from being over 65 ºC. The range of operating temperature may degrade in case of improper thermal management in final product design.

Note (3) 11 ms, half sine wave, 1 time for ± X, ± Y, ± Z.

Note (4) 10 ~ 200 Hz, 10 min, 1 time each X, Y, Z.

Note (5) At testing Vibration and Shock, the fixture in holding the module has to be hard and rigid enough so that the module would not be twisted or bent by the fixture.



## 2.2 PACKAGE STORAGE

When storing modules as spares for a long time, the following precaution is necessary.

(a) Do not leave the module in high temperature, and high humidity for a long time. It is highly recommended to store the module with temperature from 0 to 35℃ at normal humidity without condensation.

(b)The module shall be stored in dark place. Do not store the TFT-LCD module in direct sunlight or fluorescent light.

## 2.3 ELECTRICAL ABSOLUTE RATINGS

### 2.3.1 TFT LCD MODULE

| Item | Symbol | Value | | Unit | Note |
|---|---|---|---|---|---|
| | | Min. | Max. | | |
| Power Supply Voltage | Vcc | -0.3 | 13.5 | V | |
| Input Signal Voltage | $V_{IN}$ | -0.3 | 3.6 | V | |

### 2.3.2 BACKLIGHT UNIT

| Item | Symbol | Test Condition | Min. | Type | Max. | Unit | Note |
|---|---|---|---|---|---|---|---|
| Light Bar Voltage | $V_W$ | Ta = 25 ℃ | - | - | 60 | $V_{RMS}$ | |
| Converter Input Voltage | $V_{BL}$ | - | 0 | - | 30 | V | |
| Control Signal Level | - | - | -0.3 | - | 7 | V | |

Note (1) Permanent damage to the device may occur if maximum values are exceeded. Functional operation should be restricted to the conditions described under normal operating conditions.

Note (2) No moisture condensation or freezing.

Note (3) The control signals include On/Off Control and Internal PWM Control.

## 3. ELECTRICAL CHARACTERISTICS

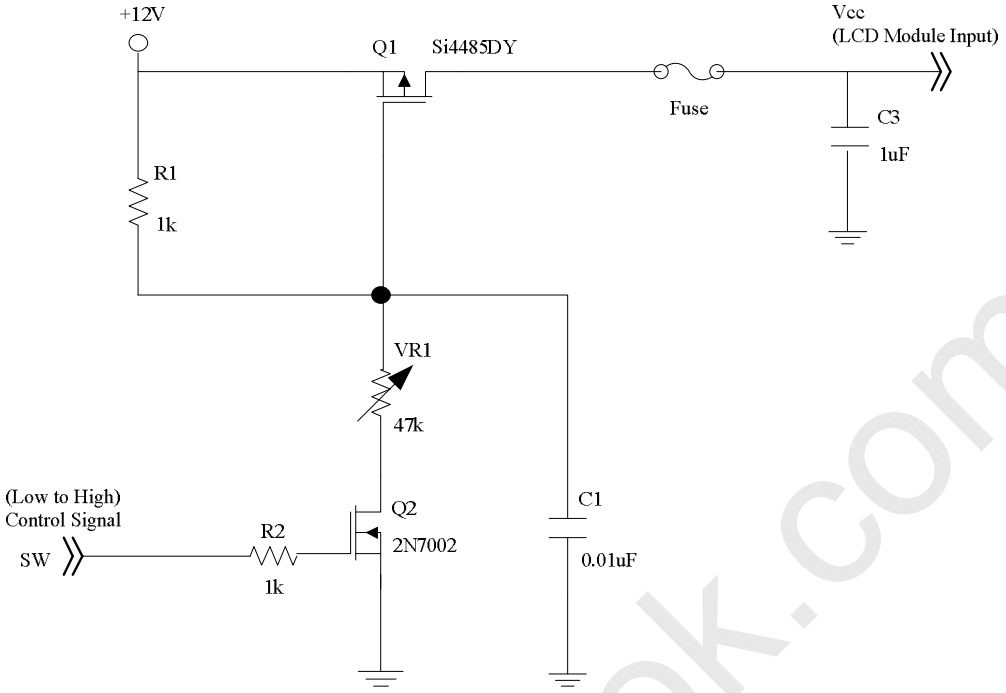
### 3.1 TFT LCD MODULE

Ta = 25 ± 2 ºC

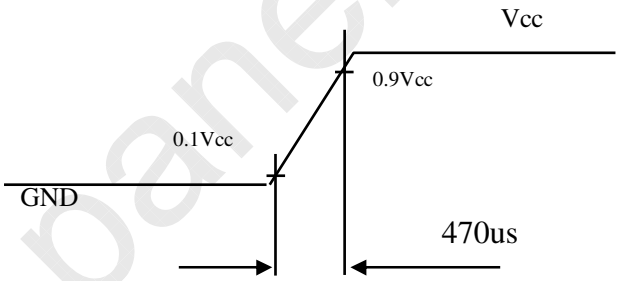
| Parameter | | Symbol | Value | | | Unit | Note |
|---|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | | |
| Power Supply Voltage | | $V_{CC}$ | 10.8 | 12 | 13.2 | V | (1) |
| Rush Current | | $I_{RUSH}$ | - | - | 4.2 | A | (2) |
| Power Supply Current | White Pattern | - | - | 1.81 | | A | (3) |
| | Horizontal Stripe | - | - | 1.54 | | A | |
| | Black Pattern | - | - | 0.58 | - | A | |
| LVDS interface | Differential Input High Threshold Voltage | $V_{LVTH}$ | +100 | - | - | mV | (4) |
| | Differential Input Low Threshold Voltage | $V_{LVTL}$ | - | - | -100 | mV | |
| | Common Input Voltage | $V_{CM}$ | 1.0 | 1.2 | 1.4 | V | |
| | Differential input voltage | $\|V_{ID}\|$ | 200 | - | 600 | mV | |
| | Terminating Resistor | $R_T$ | - | 100 | - | ohm | |
| CMOS interface | Input High Threshold Voltage | $V_{IH}$ | 2.7 | - | 3.3 | V | |
| | Input Low Threshold Voltage | $V_{IL}$ | 0 | - | 0.7 | V | |

Note (1) The module should be always operated within above ranges.

Note (2) Measurement Conditions:

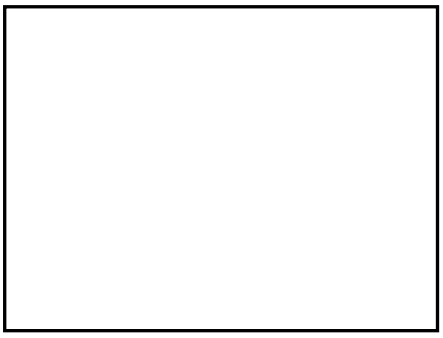



**Vcc rising time is 470us**




Note (3) The specified power supply current is under the conditions at Vcc =12V, Ta = 25 ± 2 ºC, $f_v$ = 120 Hz, whereas a power dissipation check pattern below is displayed.

a. White Pattern

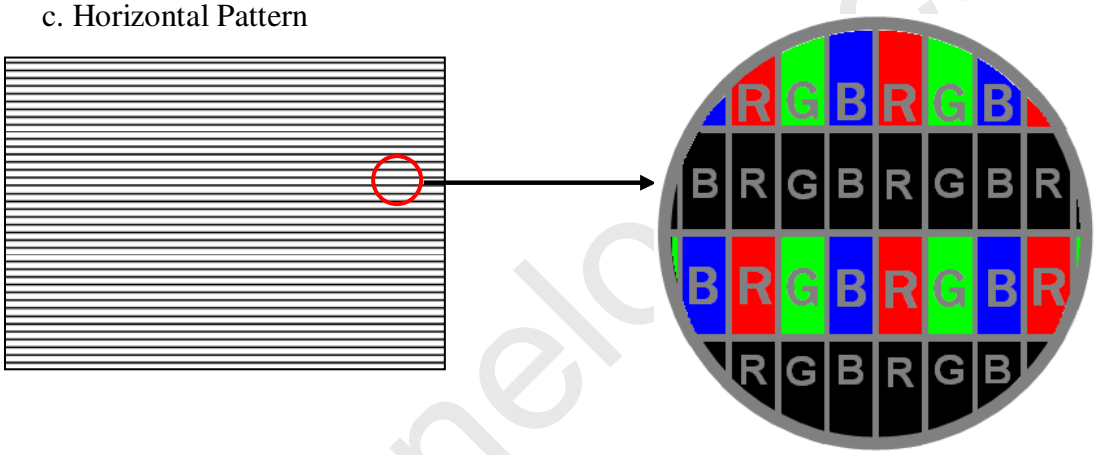


Active Area

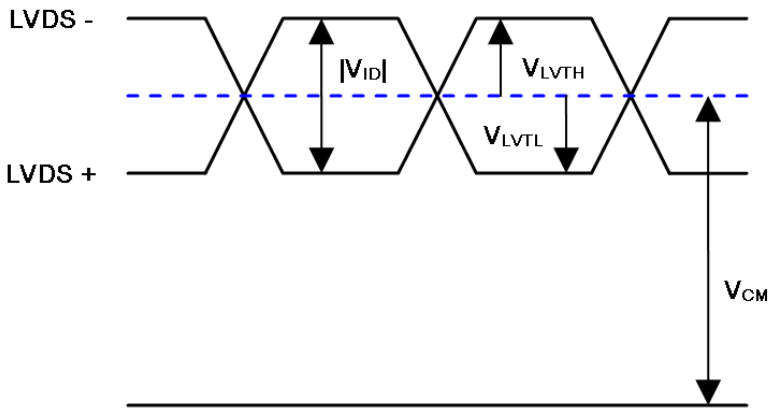
b. Black Pattern

Active Area

c. Horizontal Pattern




Note (4) The LVDS input characteristics are as follows:



## 3.2 BACKLIGHT CONVERTER UNIT

### 3.2.1 LED LIGHT BARCHARACTERISTICS (Ta = 25 ± 2 ºC)

| Parameter | Symbol | Value | | | Unit | Note |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Light Bar Voltage | $V_W$ | - | - | 47.6 | $V_{RMS}$ | $I_L$ =80 mA |
| LED Forward Voltage | $V_f$ | 3.0 | - | 3.4 | $V_{RMS}$ | $I_L$ =80mA |
| LED Current | $I_L$ | 75.2 | 80 | 84.8 | mA | |

### 3.2.2 CONVERTER CHARACTERISTICS (Ta = 25 ± 2 ºC)

| Parameter | Symbol | Value | | | Unit | Note |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Power Consumption | $P_{BL}$ | - | TBD | 86 | W | |
| Converter Input Voltage | $V_{BL}$ | 22.8 | 24 | 25.2 | $V_{DC}$ | |
| Converter Input Current | $I_{BL}$ | - | TBD | 3.6 | A | |
| Dimming Frequency | $F_B$ | 150 | 160 | 170 | Hz | |
| Minimum Duty Ratio | $D_{MIN}$ | 5 | 10 | - | % | (1) |

Note (1) 5% minimum duty ratio is only valid for electrical operation.

### 3.2.3 CONVERTER INTERFACE CHARACTERISTICS

External dimming: 150Hz~170Hz, duty ratio: 10%~100%

| Parameter | | Symbol | Test Condition | Value | | | Unit | Note |
|---|---|---|---|---|---|---|---|---|
| | | | | Min. | Typ. | Max. | | |
| On/Off Control Voltage | ON | VBLON | — | 2.0 | — | 5.0 | V | |
| | OFF | | — | 0 | — | 0.8 | V | |
| Internal PWM Control Voltage | MAX | VIPWM | — | 3.15 | — | 3.45 | V | maximum duty ratio |
| | MIN | | — | — | 0 | — | V | minimum duty ratio |
| External PWM Control Voltage | HI | VEPWM | — | 2.0 | — | 5.0 | V | Duty on |
| | LO | | — | 0 | — | 0.8 | V | Duty off |
| Status Signal | HI | Status | — | 3.0 | 3.3 | 3.6 | V | Normal |
| | LO | | — | 0 | — | 0.8 | V | Abnormal |
| VBL Rising Time | | Tr1 | — | 30 | — | — | ms | 10%-90%$V_{BL}$ |
| VBL Falling Time | | Tf1 | — | 30 | — | — | ms | |
| Control Signal Rising Time | | Tr | — | — | — | 100 | ms | |
| Control Signal Falling Time | | Tf | — | — | — | 100 | ms | |
| PWM Signal Rising Time | | TPWMR | — | — | — | 50 | us | |
| PWM Signal Falling Time | | TPWMF | — | — | — | 50 | us | |
| Input Impedance | | Rin | — | 1 | — | — | MΩ | |
| PWM Delay Time | | TPWM | — | 100 | — | — | ms | |
| BLON Delay Time | | $T_{on}$ | — | 300 | — | — | ms | |
| | | $T_{on1}$ | — | 300 | — | — | ms | |
| BLON Off Time | | Toff | — | 300 | — | — | ms | |

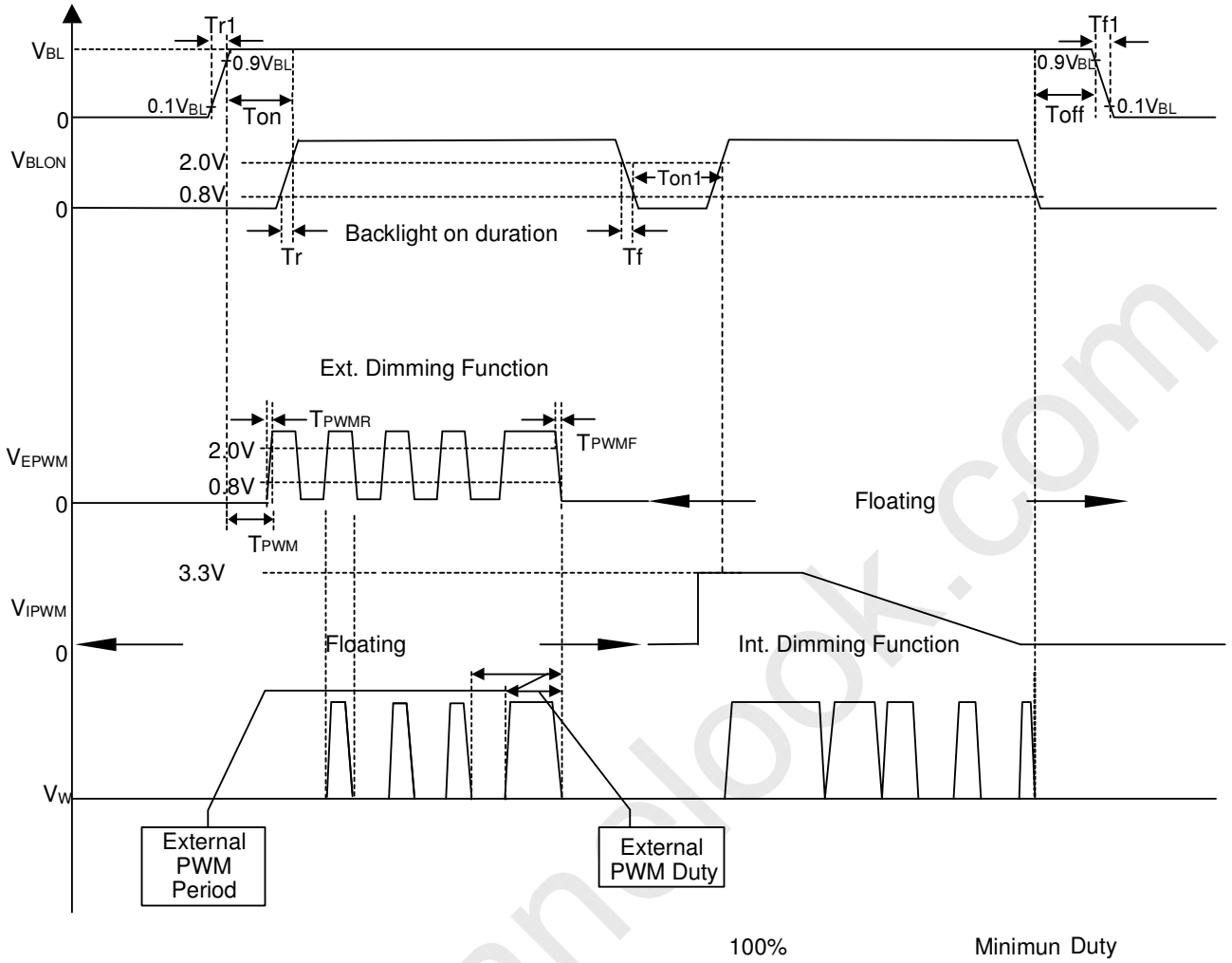
Note (1) The Dimming signal should be valid before backlight turns on by BLON signal. It is inhibited to change the internal/external PWM signal during backlight turn on period.

Note (2) The power sequence and control signal timing are shown in the following figure. For a certain reason, the converter has a possibility to be damaged with wrong power sequence and control signal timing.

Note (3) While system is turned ON or OFF, the power sequences must follow as below descriptions:

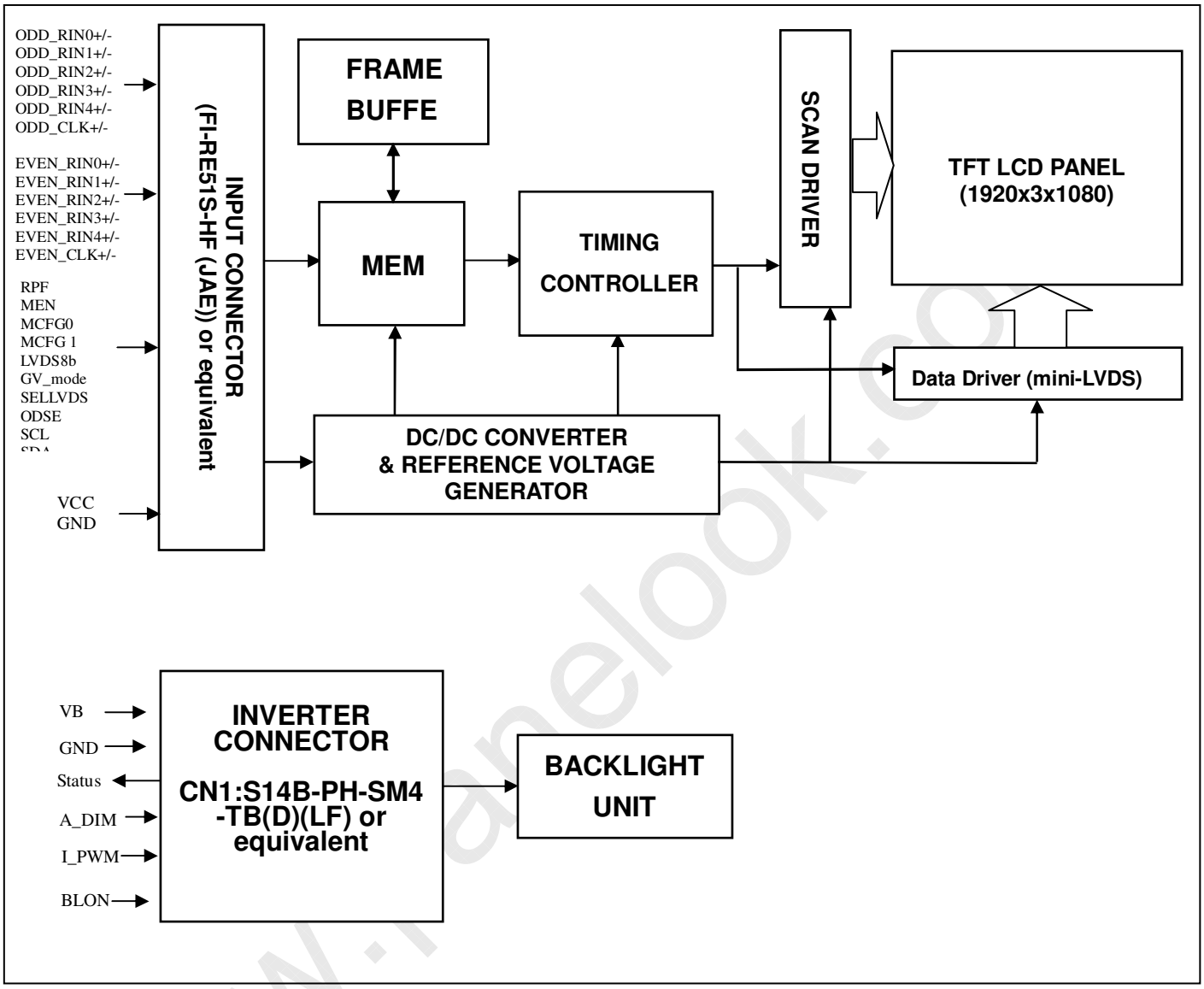
Turn ON sequence: VBL → PWM signal → BLON

Turn OFF sequence: BLOFF → PWM signal → VBL



## 4. BLOCK DIAGRAM OF INTERFACE

### 4.1 TFT LCD MODULE



## 5. INTERFACE PIN CONNECTION

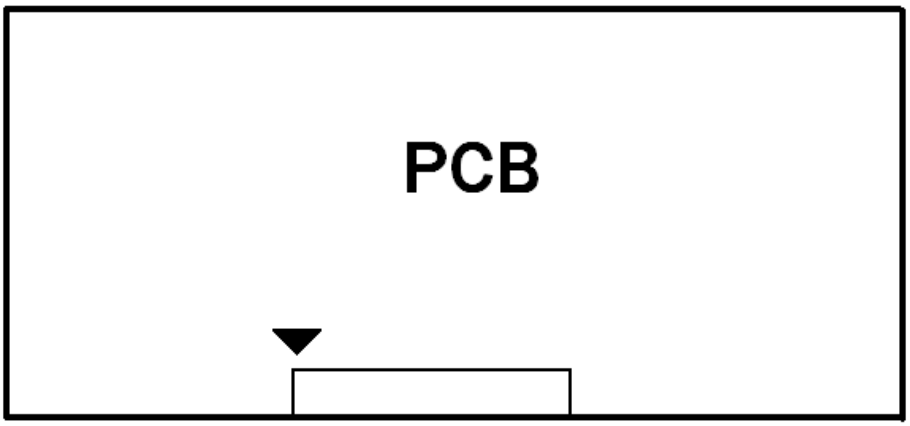
### 5.1 TFT LCD MODULE

CNF1 Connector Pin Assignment: (FI-RE51S-HF(JAE) or equivalent)

| Pin | Name | Description | Note |
|---|---|---|---|
| 1 | RPF | Reverse picture function (default low) | 8 |
| 2 | MEN | MEMC function selection | 5 |
| 3 | MCFG0 | MEMC function selection | 5 |
| 4 | MCFG1 | MEMC function selection | 5 |
| 5 | LVDS8b | 8bit/10bit LVDS input selection | 6 |
| 6 | GV_mode | Graphic / Video mode selection | 7 |
| 7 | SELLVDS | LVDS data format Selection | 3 |
| 8 | SCL | I2C CLK Signal | |
| 9 | SDA. | I2C Data Signal | |
| 10 | ODSEL | Overdrive Lookup Table Selection | 4 |
| 11 | GND | Ground | |
| 12 | ERX0- | 2nd pixel Negative LVDS differential data input. Channel 0 | |
| 13 | ERX0+ | 2nd pixel Positive LVDS differential data input. Channel 0 | |
| 14 | ERX1- | 2nd pixel Negative LVDS differential data input. Channel 1 | |
| 15 | ERX1+ | 2nd pixel Positive LVDS differential data input. Channel 1 | |
| 16 | ERX2- | 2nd pixel Negative LVDS differential data input. Channel 2 | |
| 17 | ERX2+ | 2nd pixel Positive LVDS differential data input. Channel 2 | |
| 18 | GND | Ground | |
| 19 | ECLK- | 2nd pixel Negative LVDS differential clock input. | |
| 20 | ECLK+ | 2nd pixel Positive LVDS differential clock input. | |
| 21 | GND | Ground | |
| 22 | ERX3- | 2nd pixel Negative LVDS differential data input. Channel 3 | |
| 23 | ERX3+ | 2nd pixel Positive LVDS differential data input. Channel 3 | |
| 24 | ERX4- | 2nd pixel Negative LVDS differential data input. Channel 4 | |
| 25 | ERX4+ | 2nd pixel Positive LVDS differential data input. Channel 4 | |
| 26 | N.C. | No Connection | 2 |
| 27 | N.C. | No Connection | 2 |
| 28 | ORX0- | 1st pixel Negative LVDS differential data input. Channel 0 | |
| 29 | ORX0+ | 1st pixel Positive LVDS differential data input. Channel 0 | |
| 30 | ORX1- | 1st pixel Negative LVDS differential data input. Channel 1 | |
| 31 | ORX1+ | 1st pixel Positive LVDS differential data input. Channel 1 | |
| 32 | ORX2- | 1st pixel Negative LVDS differential data input. Channel 2 | |
| 33 | ORX2+ | 1st pixel Positive LVDS differential data input. Channel 2 | |
| 34 | GND | Ground | |
| 35 | OCLK- | 1st pixel Negative LVDS differential clock input. | |
| 36 | OCLK+ | 1st pixel Positive LVDS differential clock input. | |
| 37 | GND | Ground | |
| 38 | ORX3- | 1st pixel Negative LVDS differential data input. Channel 3 | |
| 39 | ORX3+ | 1st pixel Positive LVDS differential data input. Channel 3 | |
| 40 | ORX4- | 1st pixel Negative LVDS differential data input. Channel 4 | |

| | | | |
|---|---|---|---|
| 41 | ORX4+ | 1st pixel Positive LVDS differential data input. Channel 4 | |
| 42 | N.C. | No Connection | 2 |
| 43 | N.C. | No Connection | 2 |
| 44 | GND | Ground | |
| 45 | GND | Ground | |
| 46 | GND | Ground | |
| 47 | N.C. | No Connection | 2 |
| 48 | VCC | +12V power supply | |
| 49 | VCC | +12V power supply | |
| 50 | VCC | +12V power supply | |
| 51 | VCC | +12V power supply | |

Note (1) LVDS connector pin orderdefined as follows




LVDS connector

Note (2) Reserved for internal use. Please leave it open.

Note (3)

| SELLVDS | Mode |
|---|---|
| L(default) | VESA |
| H | JEIDA |

L: Connect to GND, H: Connect to +3.3V

Note (4) Overdrive lookup table selection. The overdrive lookup table should be selected in accordance with the frame rate to optimize image quality.

| ODSEL | Description |
|---|---|
| L(default) | Lookup table was optimized for 60 Hz frame rate input. |
| H | Lookup table was optimized for 50 Hz frame rate input. |

L: Connect to GND, H: Connect to +3.3V

Note (5) Motion Engine (ME) Level & Demo Function Table

Motion engine level must be adjusted after video mode is selected (or entered).

Adjusting the motion engine level in graphic mode has no effect

| | | MEN | MCFG1 | MCFG0 | Notes | | |
|---|---|---|---|---|---|---|---|
| Blanking | Blanking disable | 0 | 0 | 0 | (a) | | |
| | Auto blanking | 0 | 0 | 1 | (b) | | |
| | Blanking enable | 0 | 1 | 0 | (c) | | |
| | | | | | | | |
| | | | | Effect of ME → | De blur | De judder | Halo |
| Demo mode (d) | | 0 | 1 | 1 | Demo Window | | |
| ME Level | Strong | 1 | 0 | 0 | Enable | Strong | Strong |
| | Medium(Default) | 1 | 0 | 1 | Enable | Normal | Normal |
| | Weak | 1 | 1 | 0 | Enable | Weak | × |
| | OFF | 1 | 1 | 1 | × | × | × |
| | | (e) (f) (g) | | | | | |

(a) Module re-starts processing video signals from Frontend scaler control board.

(b) During sync unstable period such as format change, 60Hz <-> 50Hz .
MCFG0 can be used to insert blanking of 500ms. This signal is toggled.

(c) Module continues to insert blanking until blanking disable signal is received from frontend scaler board.

(d) Demo window mode: Demo Window appears to the left half of display area. Left side with frame is 120Hz with MEMC, and right side is 120Hz w/o motion compensation.

(e) GPIO (General Purpose I/O) sequence of ME Level: (1) MEN; (2) MCFG1; (3) MCFG0.
GPIO sequence of Blanking Enable, Blanking Disable and Demo window: (1) MCFG1; (2) MCFG0; (3) MEN.

(f) Each scaler command must be maintained the same voltage level at least 100ms.

(g) 0 : Connect to GND, 1 : +3.3V

Note (6) 8bit/10bit LVDS input selection

| LVDS8b | Bit depth |
|---|---|
| H(default) | 8bit |
| L | 10bit |

L : Connect to GND, H : Connect to +3.3V

Note (7) Graphic / Video mode selection

There is no prohibited time period for switching between Graphic mode and Video mode.

When this switching signal is input, LCD will be reset and will re-start selected mode.

| GV_mode | Mode select | MEMC ON/OFF |
|---|---|---|
| H(default) | Graphic mode | MEMC OFF |
| L | Video mode | MEMC ON |

L : Connect to GND, H : Connect to +3.3V

Note (8)

| **SELLVDS** | **Mode** |
|---|---|
| **L(default)** | Normal Display |
| **H** | Rotation Display |

L: Connect to GND, H: Connect to +3.3V

## 5.2 BACKLIGHT UNIT

The pin configuration for the housing and leader wire is shown in the table below.

CN2-CN7 (Housing): 51281-1094 (Molex)

| Pin No. | Symbol | Description |
|---|---|---|
| 1 | VLED | Positive of LED String |
| 2 | VLED | |
| 3 | NC | No Connection |
| 4 | NC | |
| 5 | NC | |
| 6 | N1 | Negative of LED String |
| 7 | N2 | |
| 8 | N3 | |
| 9 | N4 | |
| 10 | N5 | |

Note (1) The backlight interface housing for high voltage side is a model 51281-0994, manufactured by Molex or equivalent. The mating header on converter part number is 51281-0994

### 5.3 CONVERTER UNIT

CN1(Header): S14B-PH-SM3-TB (JST) or equivalent

| Pin No. | Symbol | Description |
|---|---|---|
| 1 | VBL | +24V Power input |
| 2 | | |
| 3 | | |
| 4 | | |
| 5 | | |
| 6 | GND | Ground |
| 7 | | |
| 8 | | |
| 9 | | |
| 10 | | |
| 11 | STATUS | Normal (3.3V)<br>Abnormal (0V) |
| 12 | E_PWM | External PWM control signal |
| 13 | I_PWM | Internal PWM control signal |
| 14 | BLON | Backlight on/off control |

Notice:

#PIN 12:PWM Dimming Control (Use Pin 12) : Pin 13 must open.

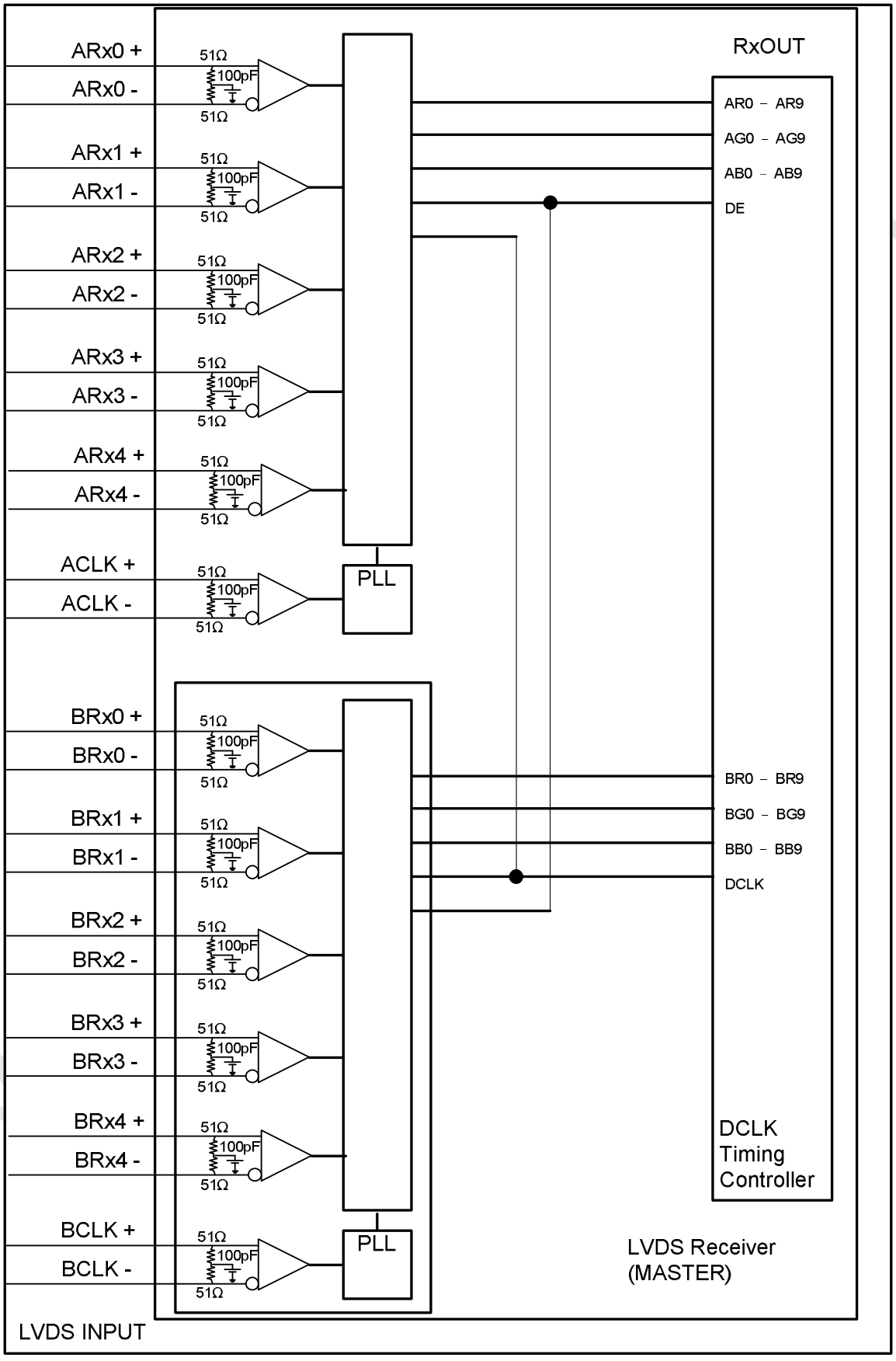
#PIN 13:Analog Dimming Control (Use Pin 13) : 0V~3.3V and Pin 12 must open.

#Pin 13(I_PWM) and Pin 12(E_PWM) can not open in same period.

CN2 ~ CN5 : 51281-1094 (Molex)

| Pin № | Symbol | Feature |
|---|---|---|
| 1 | VLED5- | Negative of LED String |
| 2 | VLED4- | |
| 3 | VLED3- | |
| 4 | VLED2- | |
| 5 | VLED1- | |
| 6 | NC | No Connection |
| 7 | NC | |
| 8 | NC | |
| 9 | VLED+ | Positive of LED String |
| 10 | VLED+ | |

## 5.4 BLOCK DIAGRAM OF INTERFACE



AR0~AR9: First pixel R data
AG0~AG9: First pixel G data
AB0~AB9: First pixel B data
BR0~BR9: Second pixel R data
BG0~BG9: Second pixel G data
BB0~BB9: Second pixel B data
DE: Data enable signal
DCLK: Data clock signal

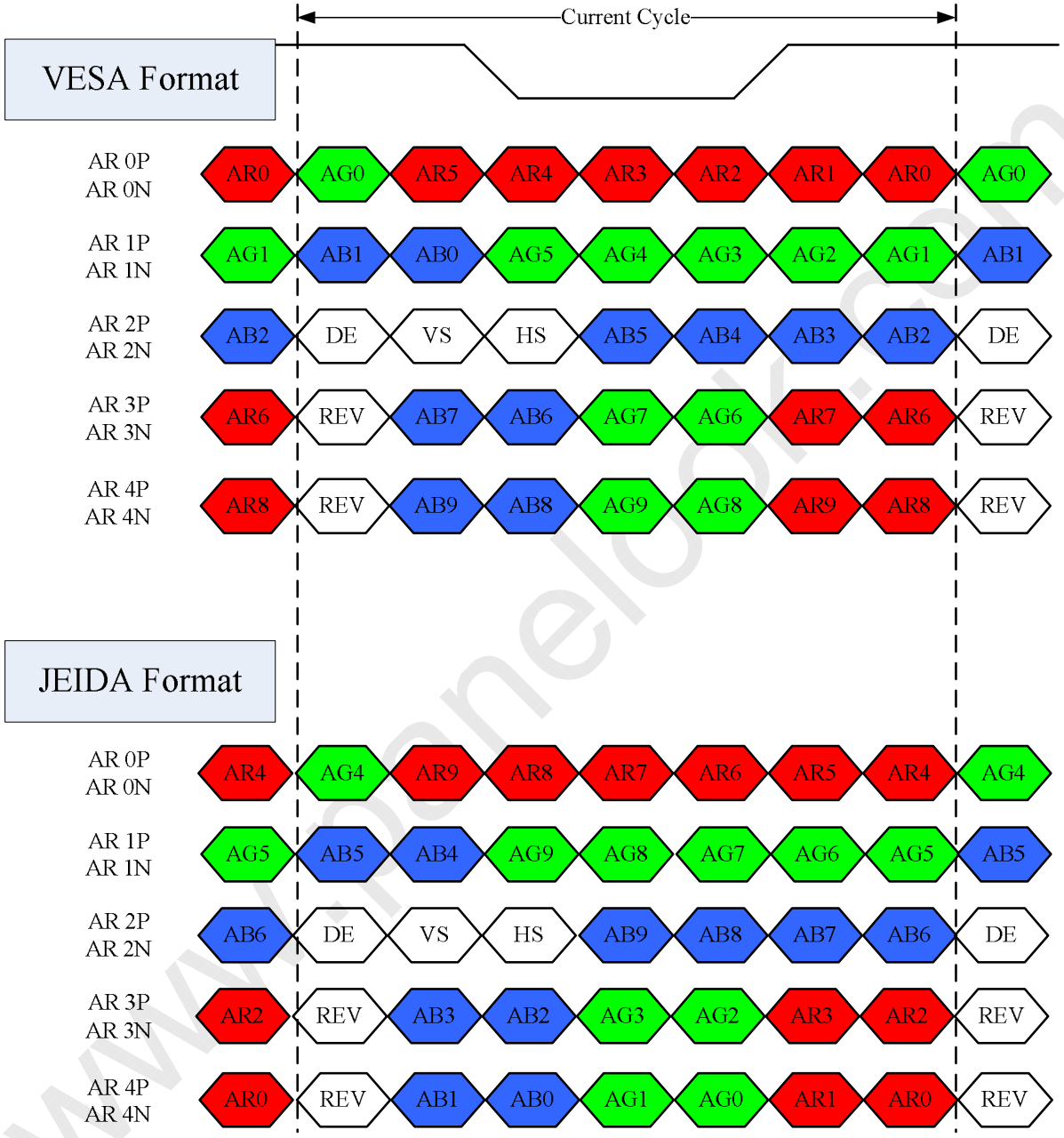
The third and fourth pixel are followed the same rules.
CR0~CR9: Third pixel R data
CG0~CG9: Third pixel G data
CB0~CB9: Third pixel B data
DR0~DR9: Fourth pixel R data
DG0~DG9: Fourth pixel G data
DB0~DB9: Fourth pixel B data

Note (1) A ~ D channel are first, second, third and fourth pixel respectively.
Note (2) The system must have the transmitter to drive the module.
Note (3) LVDS cable impedance shall be 50 ohms per signal line or about 100 ohms per twist-pair line when it is used differentially.

### 5.5 LVDS INTERFACE

VESA Format : SELLVDS = L or Open

JEIDA Format : SELLVDS = H




AR0~AR9: First Pixel R Data (9; MSB, 0; LSB)

AG0~AG9: First Pixel G Data (9; MSB, 0; LSB)

AB0~AB9: First Pixel B Data (9; MSB, 0; LSB)

DE : Data enable signal

DCLK : Data clock signal

RSVD : Reserved

## 5.6 COLOR DATA INPUT ASSIGNMENT

The brightness of each primary color (red, green and blue) is based on the 10-bit gray scale data input for the color. The higher the binary input, the brighter the color. The table below provides the assignment of the color versus data input.

| Color | | Data Signal | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Red | | | | | | | | | | Green | | | | | | | | | | Blue | | | | | | | | | |
| | | R9 | R8 | R7 | R6 | R5 | R4 | R3 | R2 | R1 | R0 | G9 | G8 | G7 | G6 | G5 | G4 | G3 | G2 | G1 | G0 | B9 | B8 | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 |
| Basic Colors | Black | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Blue | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Cyan | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Magenta | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Yellow | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | White | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Gray Scale Of Red | Red (0) / Dark | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red (1) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red (2) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | : | | | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : |
| | : | | | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | ; | : | : | : | : | : | : | : | : | : |
| | Red (1021) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red (1022) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red (1023) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gray Scale Of Green | Green (0) / Dark | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green (1) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green (2) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : |
| | Green (1021) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green (1022) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green (1023) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gray Scale Of Blue | Blue (0) / Dark | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Blue (1) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| | Blue (2) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : |
| | Blue (1021) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 |

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Blue (1022) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| | Blue (1023) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

Note (1) 0: Low Level Voltage, 1: High Level Voltage

# 6. INTERFACE TIMING

## 6.1 INPUT SIGNAL TIMING SPECIFICATIONS

(Ta = 25 ± 2 ºC)

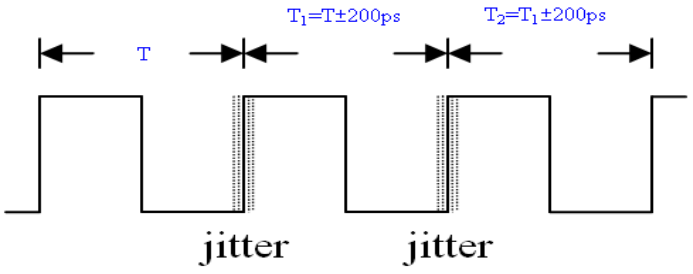
The input signal timing specifications are shown as the following table and timing diagram.

| Signal | Item | Symbol | Min. | Typ. | Max. | Unit | Note |
|---|---|---|---|---|---|---|---|
| LVDS Receiver Clock | Frequency | $F_{clkin}$ (=1/TC) | 60 | 74.25 | 78 | MHz | |
| | Input cycle to cycle jitter | $T_{rcl}$ | — | — | 200 | ps | (3) |
| | Spread spectrum modulation range | $F_{clkin\_mod}$ | $F_{clkin}$-2% | — | $F_{clkin}$+2% | MHz | (4) |
| | Spread spectrum modulation frequency | $F_{SSM}$ | 30 | | 50 | KHz | |
| LVDS Receiver Data | Setup Time | Tlvsu | 600 | — | — | ps | (5) |
| | Hold Time | Tlvhd | 600 | — | — | ps | |
| Vertical Active Display Term | Frame Rate | $F_{r5}$ | 47 | 50 | 53 | Hz | (6) |
| | | $F_{r6}$ | 57 | 60 | 62 | Hz | |
| | Total | Tv | 1110 | 1125 | 1135 | Th | Tv=Tvd+Tvb |
| | Display | Tvd | 1080 | 1080 | 1080 | Th | — |
| | Blank | Tvb | 30 | 45 | 55 | Th | — |
| Horizontal Active Display Term | Total | Th | 1050 | 1100 | 1150 | Tc | Th=Thd+Thb |
| | Display | Thd | 960 | 960 | 960 | Tc | — |
| | Blank | Thb | 90 | 140 | 190 | Tc | — |

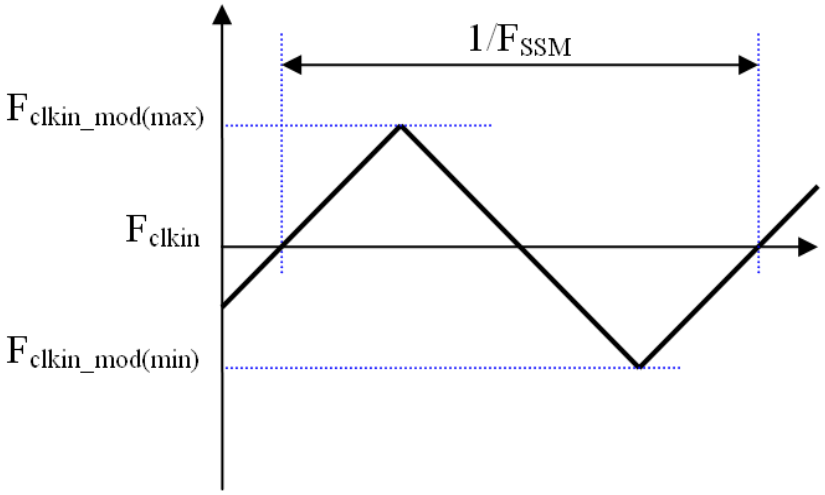
Note (1) Please make sure the range of frame rate has follow the below equation：

Fr(max) ≧ Fclkin ／ Tv×Th ≦ Fr(min)

Note (2) The input clock cycle-to-cycle jitter is defined as below figures. Trcl = I $T_1$ – TI



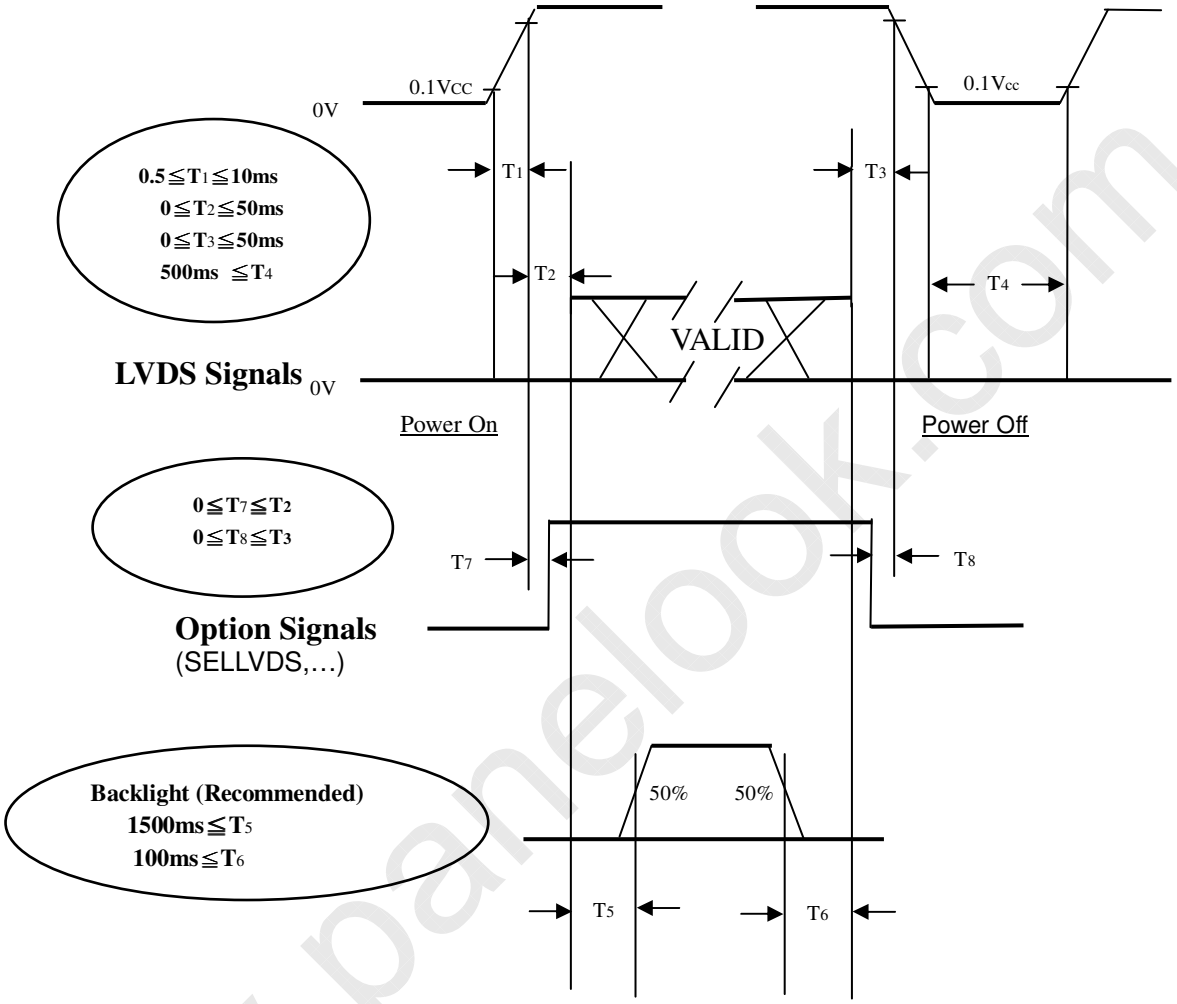
Note (3) The SSCG (Spread spectrum clock generator) is defined as below figures.



## 6.2 POWER ON/OFF SEQUENCE

(Ta = 25 ± 2 ºC)

To prevent a latch-up or DC operation of LCD module, the power on/off sequence should be as the diagram below.




**Power ON/OFF Sequence**

Note (1) The supply voltage of the external system for the module input should follow the definition of Vcc.

Note (2) Apply the lamp voltage within the LCD operation range. When the backlight turns on before the LCD operation or the LCD turns off before the backlight turns off, the display may momentarily become abnormal screen.

Note (3) In case of Vcc is in off level, please keep the level of input signals on the low or high impedance. If T2<0,that maybe cause electrical overstress failure.

Note (4) T4 should be measured after the module has been fully discharged between power off and on period.

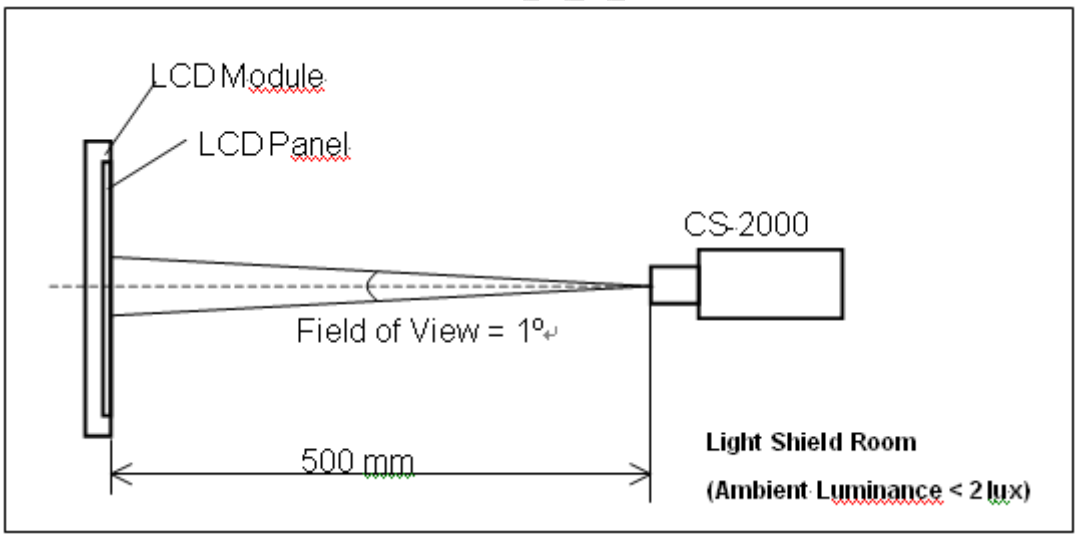
Note (5) Interface signal shall not be kept at high impedance when the power is on.

# 7. OPTICAL CHARACTERISTICS

## 7.1 TEST CONDITIONS

| Item | Symbol | Value | Unit |
|---|---|---|---|
| Ambient Temperature | Ta | 25±2 | oC |
| Ambient Humidity | Ha | 50±10 | %RH |
| Supply Voltage | VCC | 12 | V |
| Input Signal | According to typical value in "3. ELECTRICAL CHARACTERISTICS" | | |
| LED Current | IL | 80 | mA |
| Vertical Frame Rate | Fr | 120 | Hz |

The LCD module should be stabilized at given temperature for 1 hour to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting backlight for 1 hour in a windless room.



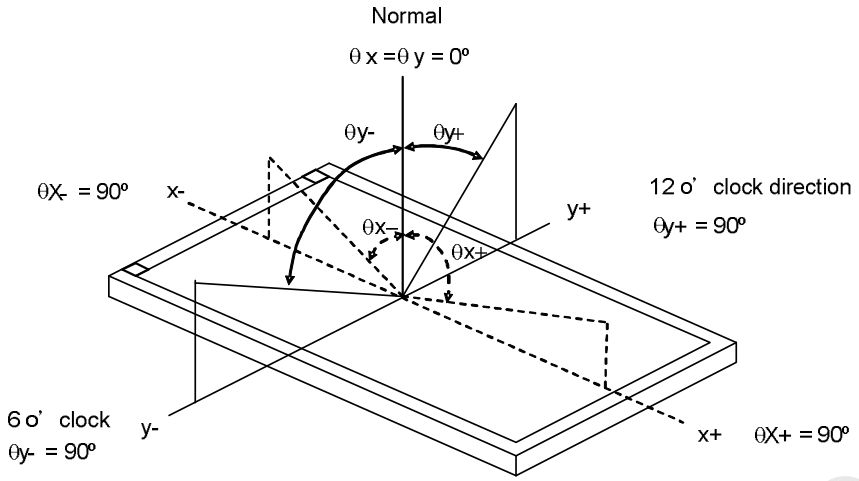
## 7.2 OPTICAL SPECIFICATIONS

The relative measurement methods of optical characteristics are shown in 7.2. The following items should be measured under the test conditions described in 7.1 and stable environment shown in 7.1.

| Item | | Symbol | Condition | Min. | Typ. | Max. | Unit | Note |
|---|---|---|---|---|---|---|---|---|
| Contrast Ratio | | CR | θx=0°, θy =0° Viewing angle at normal direction | TBD | (6000) | - | - | Note (2) |
| Response Time | | Gray to gray | | - | (5.5) | (11) | ms | Note (3) |
| Center Luminance of White | | LC | | (360) | 450 | - | $cd/m^2$ | Note (4) |
| White Variation | | δW | | - | - | (1.3) | - | Note (6) |
| Cross Talk | | CT | | - | - | (4) | % | Note (5) |
| Color Chromaticity | Red | Rx | | TBD | (0.622) | TBD | - | - |
| | | Ry | | | (0.332) | | - | |
| | Green | Gx | | | (0.319) | | - | |
| | | Gy | | | (0.615) | | - | |
| | Blue | Bx | | | (0.150) | | - | |
| | | By | | | (0.060) | | - | |
| | White | Wx | | | (0.280) | | - | |
| | | Wy | | | (0.290) | | - | |
| | Color Gamut | C.G | | -- | (70) | - | % | NTSC |
| Viewing Angle | Horizontal | θx+ | CR≥20 | 80 | 88 | - | Deg. | Note (1) |
| | | θx- | | 80 | 88 | - | | |
| | Vertical | θY+ | | 80 | 88 | - | | |
| | | θY- | | 80 | 88 | - | | |

Note (1) Definition of Viewing Angle (θx, θy):

Viewing angles are measured by Autronic Conoscope Cono-80.




Note (2) Definition of Contrast Ratio (CR):

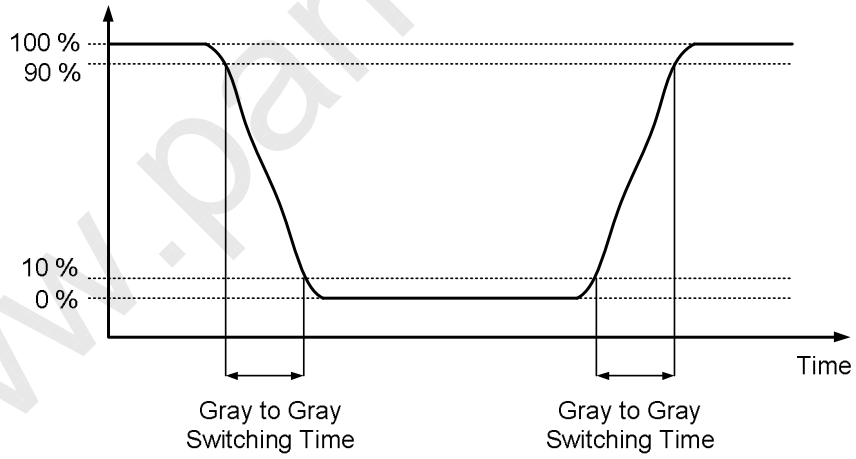
The contrast ratio can be calculated by the following expression.

$$\text{Contrast Ratio (CR)} = \frac{\text{Surface Luminance with all white pixels}}{\text{Surface Luminance with all black pixels}}$$

CR = CR (5), where CR (X) is corresponding to the Contrast Ratio of the point X at the figure in Note (6).

Note (3) Definition of Gray-to-Gray Switching Time:

**Optical Response**




The driving signal means the signal of gray level 0, 31, 63, 95, 127, 159, 191, 223, 255.

Gray to gray average time means the average switching time of gray level 0, 31, 63, 95, 127, 159, 191, 223, 255 to each other.

Note (4) Definition of Luminance of White ($L_C$):

Measure the luminance of gray level 255 at center point and 5 points

$L_C$ = L (5), where L (X) is corresponding to the luminance of the point X at the figure in Note (6).

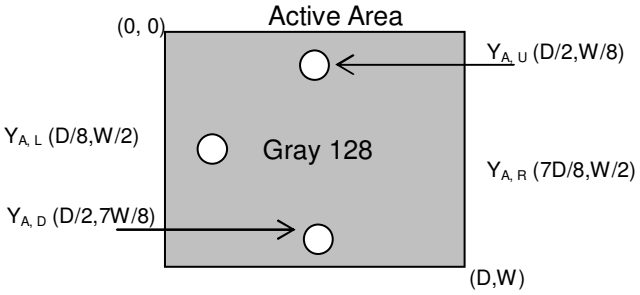
Note (5) Definition of Cross Talk (CT):

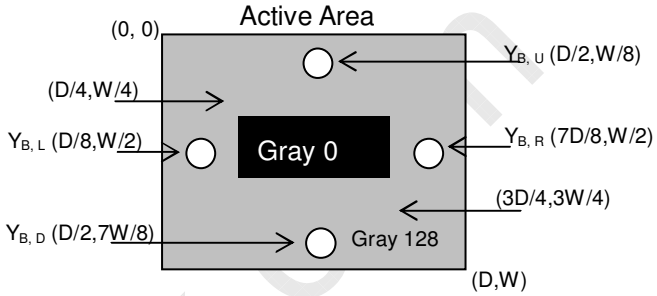
CT = | YB – YA | / YA × 100 (%)

Where:

YA = Luminance of measured location without gray level 0 pattern (cd/m2)

YB = Luminance of measured location with gray level 0 pattern (cd/m2)

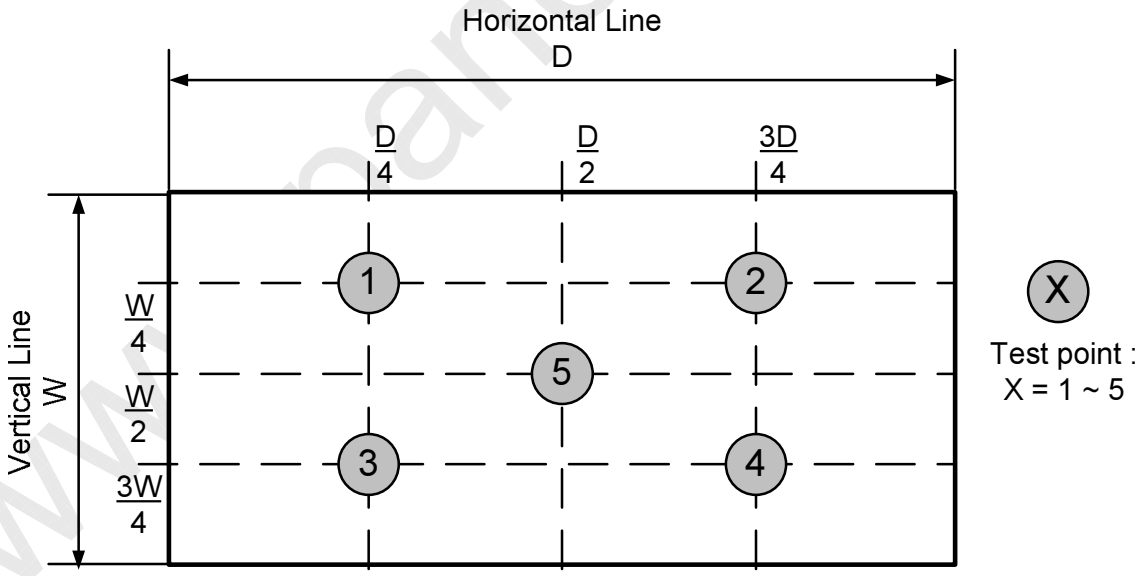



Note (6) Definition of White Variation (δW):

Measure the luminance of gray level 255 at 5 points

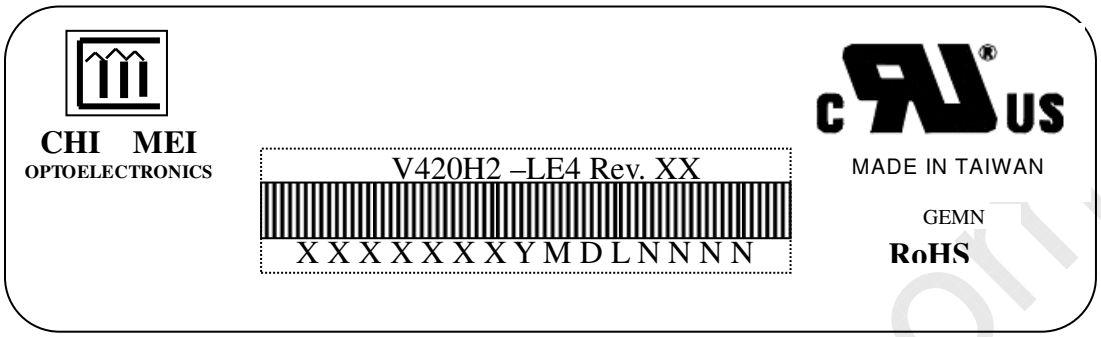
δW = Maximum [L (1), L (2), L (3), L (4), L (5)] / Minimum [L (1), L (2), L (3), L (4), L (5)]



# 8. DEFINITION OF LABELS

## 8.1 CMO MODULE LABEL

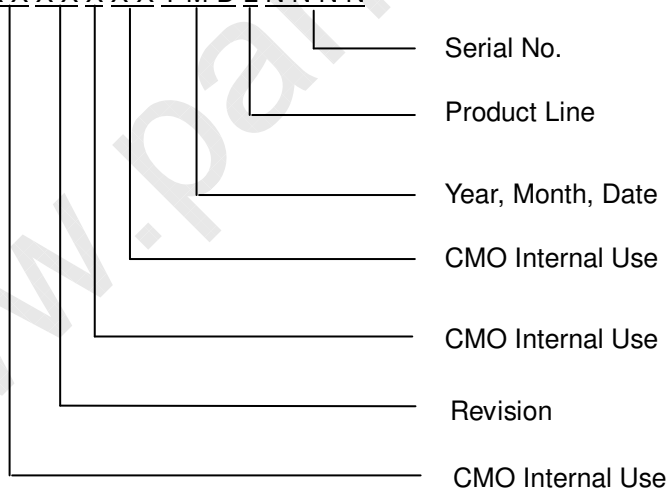
The barcode nameplate is pasted on each module as illustration, and its definitions are as following explanation.




(a) Model Name: V420H2-LE4

(b) Revision: Rev. XX, for example: A0, A1… B1, B2… or C1, C2…etc.

(c) Serial ID: X X X X X X X Y M D L N N N N




Serial ID includes the information as below:

(a) Manufactured Date: Year: 2001=1, 2002=2, 2003=3, 2004=4….2010=0, 2011=1, 2012=2....

Month: 1~9, A~C, for Jan. ~ Dec.

Day: 1~9, A~Y, for 1st to 31st, exclude I ,O, and U.

(b) Revision Code: Cover all the change

(c) Serial No.: Manufacturing sequence of product

(d) Product Line: 1 -> Line1, 2 -> Line 2, …etc.

# 9. PACKAGING

## 9.1 PACKING SPECIFICATIONS

(1) 5 LCD TV modules / 1 Box

(2) Box dimensions : 1085(L)x296(W)x653(H)mm

(3) Weight : Approx. TBD Kg(5 modules per carton)

## 9.2 PACKING METHOD

Figures 9-1 and 9-2 are the packing method

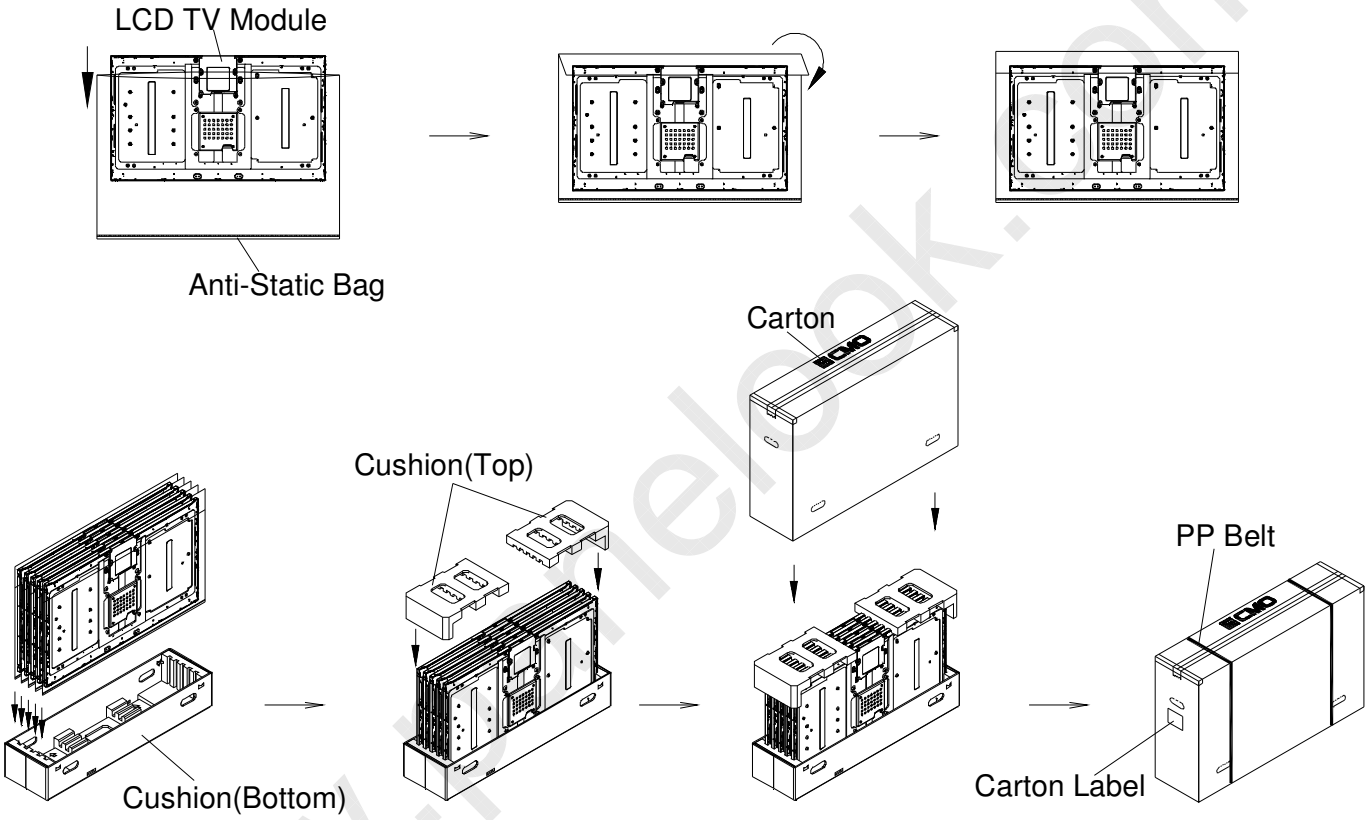
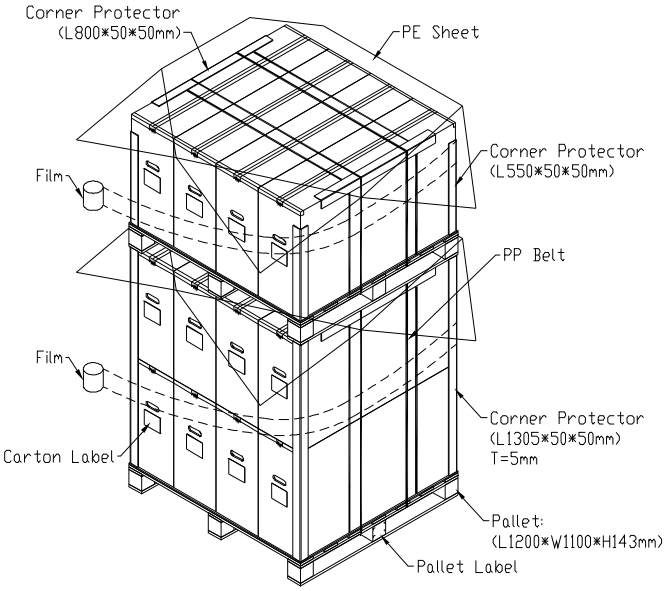



Figure.9-1 packing method

Sea / Land Transportation
(40ft Container)

Air Transportation



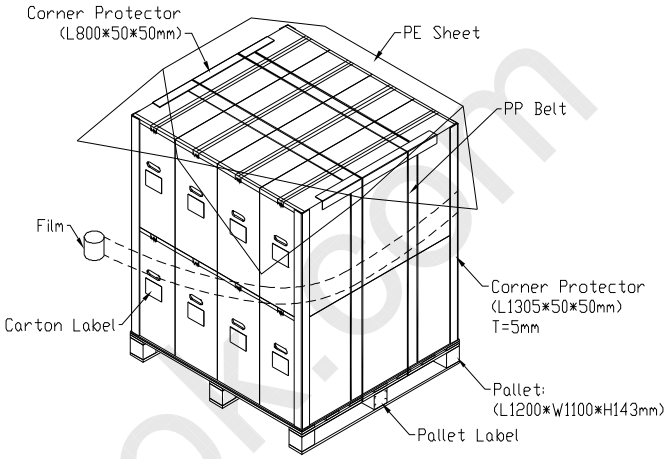




Figure.9-2 packing method

# 10. PRECAUTIONS

## 10.1 ASSEMBLY AND HANDLING PRECAUTIONS

(1) Do not apply rough force such as bending or twisting to the module during assembly.

(2) It is recommended to assemble or to install a module into the user's system in clean working areas. The dust and oil may cause electrical short or worsen the polarizer.

(3) Do not apply pressure or impulse to the module to prevent the damage of LCD panel and backlight.

(4) Always follow the correct power-on sequence when the LCD module is turned on. This can prevent the damage and latch-up of the CMOS LSI chips.

(5) Do not plug in or pull out the I/F connector while the module is in operation.

(6) Do not disassemble the module.

(7) Use a soft dry cloth without chemicals for cleaning, because the surface of polarizer is very soft and easily scratched.

(8) Moisture can easily penetrate into LCD module and may cause the damage during operation.

(9) High temperature or humidity may deteriorate the performance of LCD module. Please store LCD modules in the specified storage conditions.

(10) When ambient temperature is lower than 10ºC, the display quality might be reduced. For example, the response time will become slow, and the starting voltage of LED light bar will be higher than that of room temperature.

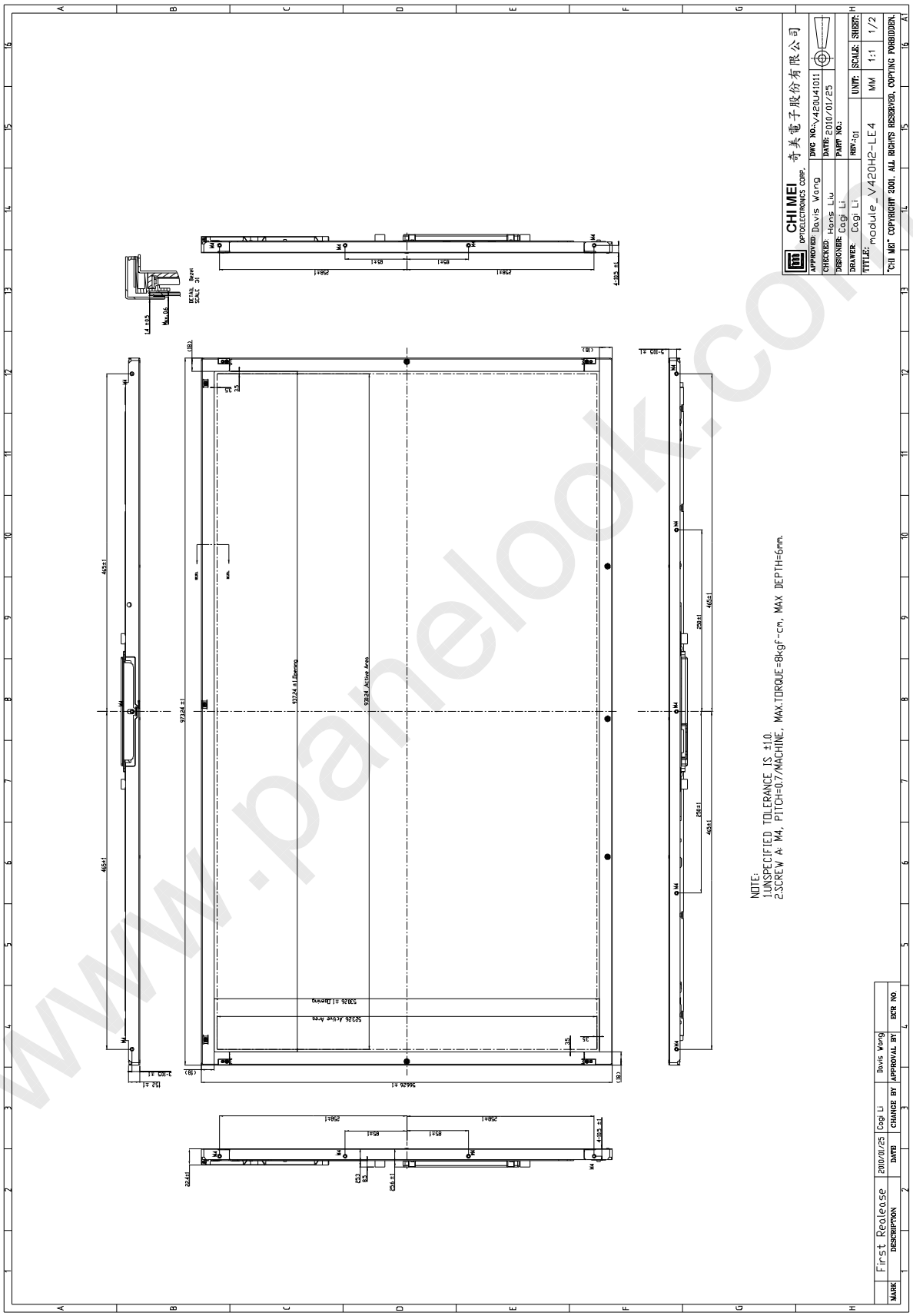
## 10.2 SAFETY PRECAUTIONS

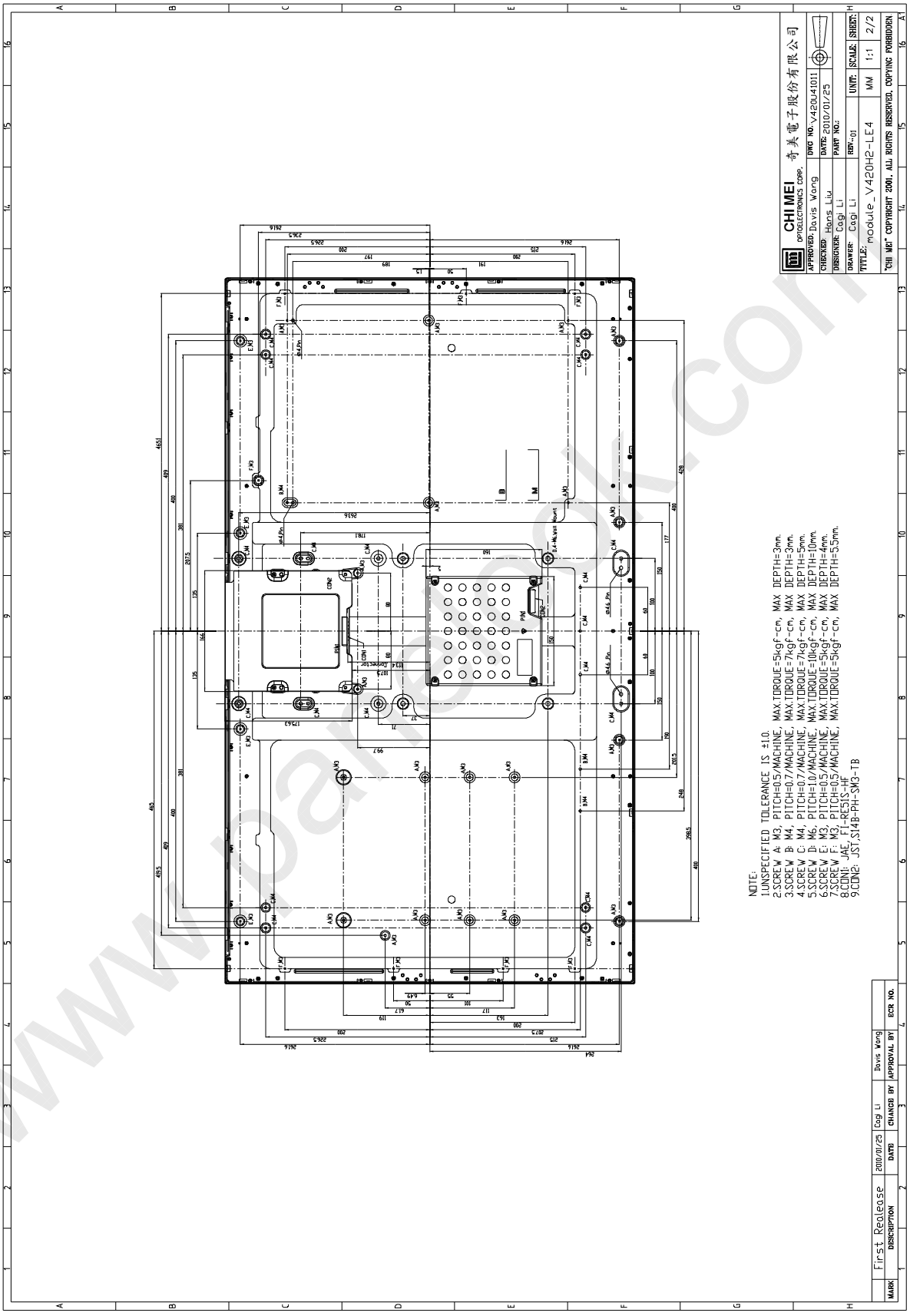
(1) The startup voltage of a backlight is over 1000 Volts. It may cause an electrical shock while assembling with the converter. Do not disassemble the module or insert anything into the backlight unit.

(2) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contact with hands, skin or clothes, it has to be washed away thoroughly with soap.

(3) After the module's end of life, it is not harmful in case of normal operation and storage.

## 11. MECHANICAL CHARACTERISTICS





# Appendix – TWO Wire BUS INTRODUCTION

## A.1 PIN ASSIGNMENT

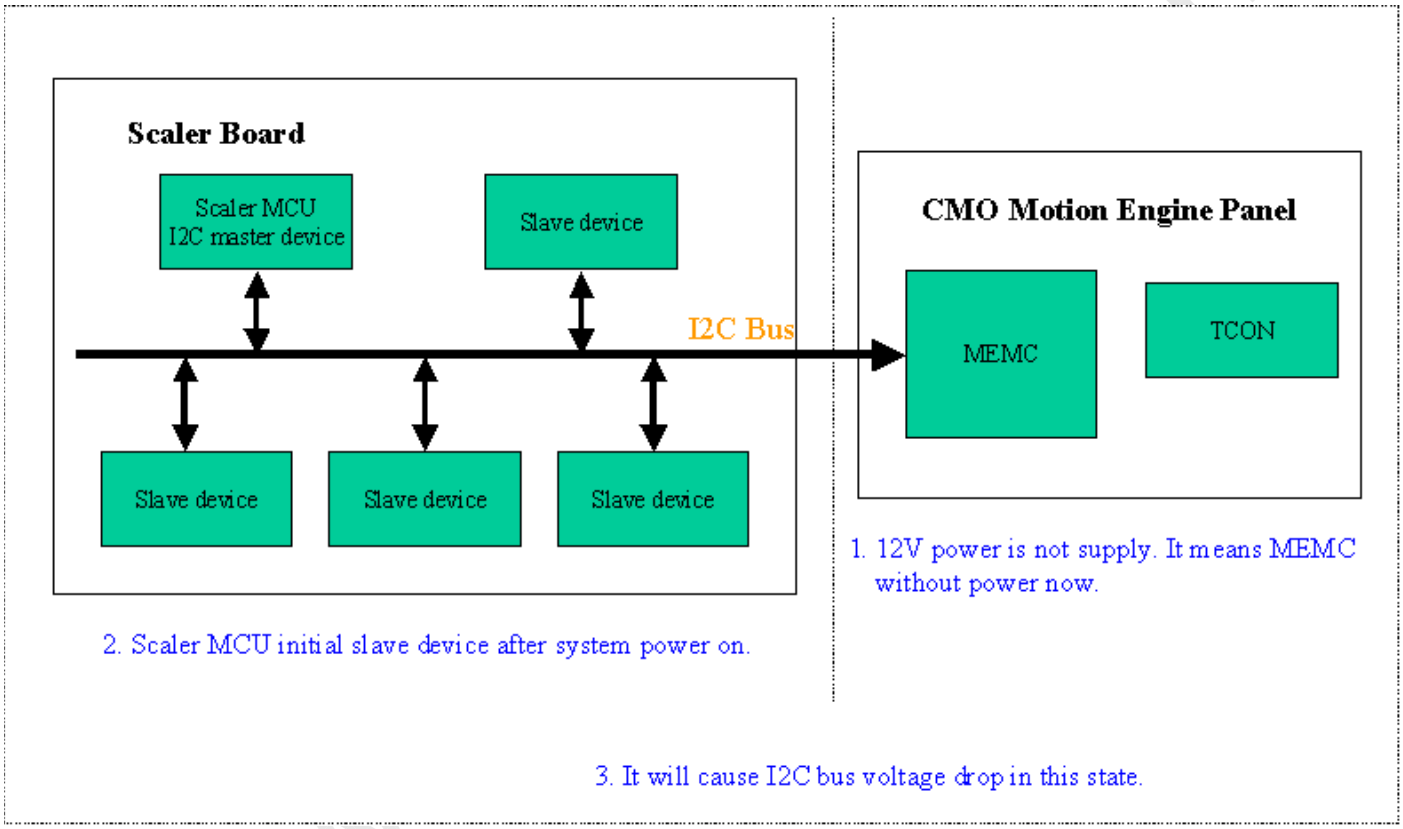
51pins LVDS connector

Pin8: SCL

Pin9: SDA

## A.2 I2C BUS APPLICATION NOTE

I2C bus: (The I2C bus must for MEMC only or prevent the I2C bus voltage drop down in initial state)



## A.3 TWO WIRE BUS DEVICE ADDRESS

Two wire device address: default is 0x40, 1 byte

Two wire command: the range is 0x00 to 0xFF, 1 byte, see the two wire command table.

### Two wire bus format:

| Device Address : 0x40 default | | | | | | | |
|---|---|---|---|---|---|---|---|
| D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| 0 | 1 | 0 | 0 | 0 | 0 | 0 | W/R |

| Command | | | | | | | |
|---|---|---|---|---|---|---|---|
| D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| L | x | x | x | x | x | x | x |

| | |
|---|---|
| W/R | write : 0; Read : 1 |
| L | 1 : 1Byte Data Length; 0: 4Byte Data Length |
| S | TWI-Bus Start condition from master |
| Sr | TWI-Bus Start condition from master |
| A | TWI-Bus Acknowledge bit from master |
| /A | TWI-Bus Not Acknowledge bit from salve |
| P | TWI-Bus Stop condition from master |
| Data | TWI Bus Data from master |
| Data | TWI Bus Data from salve |

## A.4 TWO WAY TO CONTROL THE TWO WIRE BUS

There are two options to control the two wires bus command.

### Two wire bus 6 bytes format

**TWI BUS 6 BYTES FORMATE**

**Write Operation**

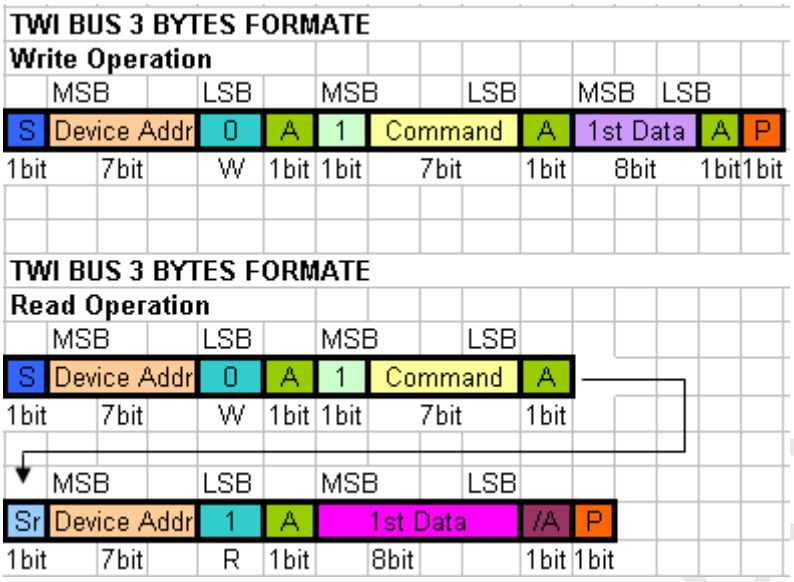
| | MSB | | LSB | | MSB | | LSB | | MSB | | | | | | | | LSB | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S | Device Addr | | 0 | A | 0 | Command | | A | 1st Data | A | 2nd Data | A | 3rd Data | A | 4th Data | A | P | |
| 1bit | 7bit | | W | 1bit | 1bit | 7bit | | 1bit | 1bit | | 1bit | | 1bit | | 1bit | | 1bit | 1bit |

**TWI BUS 6 BYTES FORMATE**

**Read Operation**

| | MSB | | LSB | | MSB | | LSB | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S | Device Addr | | 0 | A | 0 | Command | | A | | | | | | | | | | |
| 1bit | 7bit | | W | 1bit | 1bit | 7bit | | 1bit | | | | | | | | | | |
| | MSB | | LSB | | MSB | | | | | | | | | | LSB | | | |
| Sr | Device Addr | | 1 | A | 1st Data | | | A | 2nd Data | A | 3rd Data | A | 4th Data | /A | P | | | |
| 1bit | 7bit | | R | 1bit | 8bit | | | 1bit | 8bit | 1bit | 8bit | 1bit | 8bit | 1bit | bit | | | |

### Two wire bus 3 bytes format



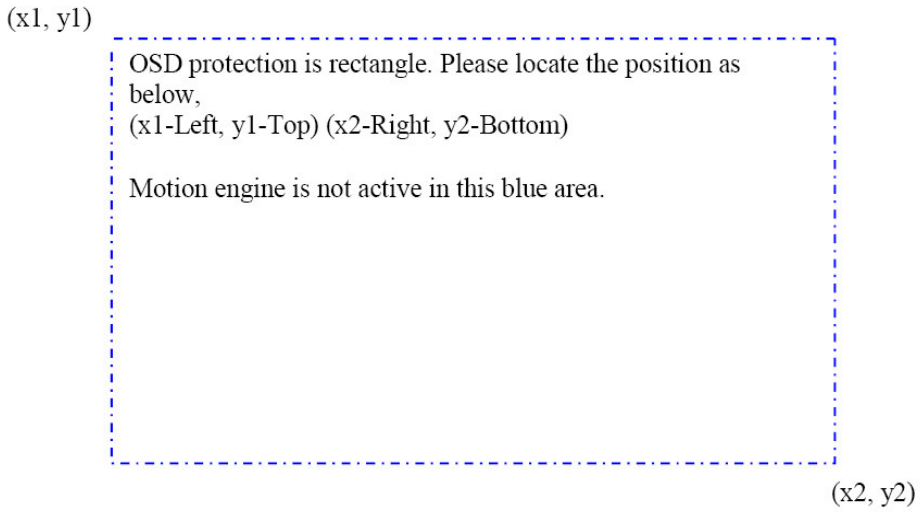

Note:

A transmission basically consists of a START condition, a SLA+R/W, one or more data packets and a STOP condition. An empty message, consisting of a START followed by a STOP condition, is illegal. Note that the wired-ANDing of the SCL line can be used to implement handshaking between the master and the slave. The slave can extend the SCL low period by pulling the SCL line low. This is useful if the clock speed set up by the master is too fast for the slave, or the slave needs extra time for processing between the data transmissions. The slave extending the SCL low period will not affect the SCL high period, which is determined by the master. As a consequence, the slave can reduce the TWI data transfer speed by prolonging the SCL duty cycle.

## A.5 TWO WIRE BUS COMMAND TABLE

There is two wire bus command table.

| Command Name | | Access Mode | Description |
|---|---|---|---|
| All OSD Protection | 0x00 | R/W | OSDx Enable Flag Contorl |
| OSD1_Start_Protection | 0x01 | R/W | OSD1 Protection Start Position |
| OSD2_Start_Protection | 0x02 | R/W | OSD2 Protection Start Position |
| OSD3_Start_Protection | 0x03 | R/W | OSD3 Protection Start Position |
| OSD4_Start_Protection | 0x04 | R/W | OSD4 Protection Start Position |
| OSD1_End_Protection | 0x05 | R/W | OSD1 Protection End Position |
| OSD2_End_Protection | 0x06 | R/W | OSD2 Protection End Position |
| OSD3_End_Protection | 0x07 | R/W | OSD3 Protection End Position |
| OSD4_End_Protection | 0x08 | R/W | OSD4 Protection End Position |
| Demo Window | 0x09 | R/W | ME Performance Demo |
| MEMC Level | 0x0A | R/W | ME Performance |
| GV Mode | 0x0B | R/W | ME Operation |
| Blanking | 0x0C | R/W | Blinking the screen |
| RPF | 0x0D | R/W | Rotation picture function |



Enable All OSD Protection

| AllOSD Protection : 0x00 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 4 Bytes Data Length | | | | | | | | | | |
| 1st BYTE DATA | D31 | D30 | D29 | D28 | D27 | D26 | D25 | D24 | D31~D28 | Unused |
| | Unused | | | | OSDx | | | | D27 | OSD4 flag 1 : On ; 0 : Off |
| 2nd BYTE DATA | D23 | D22 | D21 | D20 | D19 | D18 | D17 | D16 | D26 | OSD3 flag 1 : On ; 0 : Off |
| | Unused | | | | | | | | D25 | OSD2 flag 1 : On ; 0 : Off |
| 3rd BYTE DATA | D15 | D14 | D13 | D12 | D11 | D10 | D9 | D8 | D24 | OSD1 flag 1 : On ; 0 : Off |
| | Unused | | | | | | | | D23~D0 | Unused |
| 4th BYTE DATA | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | | |
| | Unused | | | | | | | | | |

| AllOSD Protection : 0x80 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 Byte Data Length | | | | | | | | | | |
| 1st BYTE DATA | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | D7~D4 | Unused |
| | Unused | | | | OSDx | | | | D3 | OSD4 flag 1 : On ; 0 : Off |
| | | | | | | | | | D2 | OSD3 flag 1 : On ; 0 : Off |
| | | | | | | | | | D1 | OSD2 flag 1 : On ; 0 : Off |
| | | | | | | | | | D0 | OSD1 flag 1 : On ; 0 : Off |

OSD # 1~4 Start Protection

| OSD1_Start_Protection : 0x01<br>OSD2_Start_Protection : 0x02<br>OSD3_Start_Protection : 0x03<br>OSD4_Start_Protection : 0x04 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 4 Bytes Data Length | | | | | | | | | | |
| 1st BYTE DATA | D31 | D30 | D29 | D28 | D27 | D26 | D25 | D24 | D31 | OSDx flag 1 : On ; 0 : Off |
| | | Unused | | | | | | | D30~D27 | Unused |
| 2nd BYTE DATA | D23 | D22 | D21 | D20 | D19 | D18 | D17 | D16 | D26~D16 | OSDx Left position |
| | OSD Left | | | | | | | | D15~D11 | Unused |
| 3rd BYTE DATA | D15 | D14 | D13 | D12 | D11 | D10 | D9 | D8 | D10~D0 | OSDx Top position |
| | | | | | | | | | | |
| 4th BYTE DATA | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | | |
| | OSDx Top | | | | | | | | Left position Max : 1919<br>Top position Max : 1079 | |

OSD # 1~4 End Protection

| OSD1_End_Protection : 0x05<br>OSD2_End_Protection : 0x06<br>OSD3_End_Protection : 0x07<br>OSD4_End_Protection : 0x08 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 4 Bytes Data Length | | | | | | | | | | |
| 1st BYTE DATA | D31 | D30 | D29 | D28 | D27 | D26 | D25 | D24 | D31~D27 | Unused |
| | Unused | | | | | | | | D26~D16 | OSDx Right position |
| 2nd BYTE DATA | D23 | D22 | D21 | D20 | D19 | D18 | D17 | D16 | D15~D11 | Unused |
| | OSD Right | | | | | | | | D10~D0 | OSDx Bottom position |
| 3rd BYTE DATA | D15 | D14 | D13 | D12 | D11 | D10 | D9 | D8 | | |
| | Unused | | | | | | | | | |
| 4th BYTE DATA | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | | |
| | OSD Bottom | | | | | | | | Right position Max : 1919<br>Bootom position Max : 1079 | |

Demo Window

| Demo Window : 0x09 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 4 Bytes Data Length | | | | | | | | | | |
| 1st BYTE DATA | D31 | D30 | D29 | D28 | D27 | D26 | D25 | D24 | D31~D25 | Unused |
| | Unused | | | | | | | | D24 | Demo Window 1 : On ; 0 : Off |
| 2nd BYTE DATA | D23 | D22 | D21 | D20 | D19 | D18 | D17 | D16 | D23~D0 | Unused |
| | Unused | | | | | | | | | |
| 3rd BYTE DATA | D15 | D14 | D13 | D12 | D11 | D10 | D9 | D8 | | |
| | Unused | | | | | | | | | |
| 4th BYTE DATA | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | | |
| | Unused | | | | | | | | | |

| Demo Window : 0x89 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 Byte Data Length | | | | | | | | | | |
| 1st BYTE DATA | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | D7~D1 | Unused |
| | Unused | | | | | | | | D0 | Demo Window 1 : On ; 0 : Off |

MEMC Level

| ME Level : 0x0A | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 4 Bytes Data Length | | | | | | | | | | |
| 1st BYTE DATA | D31 | D30 | D29 | D28 | D27 | D26 | D25 | D24 | D31~D29 | Unused |
| | Unused | | | | ME Level | | | | D28~24 | ME Level 0~F |
| 2nd BYTE DATA | D23 | D22 | D21 | D20 | D19 | D18 | D17 | D16 | | |
| | Unused | | | | | | | | | |
| 3rd BYTE DATA | D15 | D14 | D13 | D12 | D11 | D10 | D9 | D8 | | 0 : Off<br>3 : Weak<br>8 : Normal<br>D : Strong |
| | Unused | | | | | | | | | |
| 4th BYTE DATA | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | | |
| | Unused | | | | | | | | D23~D0 | Unused |

| ME Level : 0x8A | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 Byte Data Length | | | | | | | | | | |
| 1st BYTE DATA | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | D7~D4 | Unused |
| | Unused | | | | ME Level | | | | D3~D0 | ME Level 0~F |
| | | | | | | | | | | 0 : Off<br>3 : Weak<br>8 : Normal<br>D : Strong |

GV Mode

| GV Mode : 0x0B | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 4 Bytes Data Length | | | | | | | | | | |
| 1st BYTE DATA | D31 | D30 | D29 | D28 | D27 | D26 | D25 | D24 | D31~D25 | Unused |
| | Unused | | | | | | | | D24 | 1 : Graphic ; 0 : Video |
| 2nd BYTE DATA | D23 | D22 | D21 | D20 | D19 | D18 | D17 | D16 | D23~D0 | Unused |
| | Unused | | | | | | | | | |
| 3rd BYTE DATA | D15 | D14 | D13 | D12 | D11 | D10 | D9 | D8 | | |
| | Unused | | | | | | | | | |
| 4th BYTE DATA | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | | |
| | Unused | | | | | | | | | |

| GV Mode : 0x8B | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 Byte Data Length | | | | | | | | | | |
| 1st BYTE DATA | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | D7~D1 | Unused |
| | Unused | | | | | | | | D0 | 1 : Graphic ; 0 : Video |

Blanking (Enable/Disable)

| Blanking : 0x0C | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 4 Bytes Data Length | | | | | | | | | | |
| 1st BYTE DATA | D31 | D30 | D29 | D28 | D27 | D26 | D25 | D24 | D31~D26 | Unused |
| | Unused | | | | | | | | D24 | Blanking; 1 : On ; 0 : Off |
| 2nd BYTE DATA | D23 | D22 | D21 | D20 | D19 | D18 | D17 | D16 | D23~D0 | Unused |
| | Unused | | | | | | | | | |
| 3rd BYTE DATA | D15 | D14 | D13 | D12 | D11 | D10 | D9 | D8 | | |
| | Unused | | | | | | | | | |
| 4th BYTE DATA | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | When the input signal is unstable, the screen should be blanked. | |
| | Unused | | | | | | | | | |

| Blanking : 0x8C | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 Byte Data Length | | | | | | | | | | |
| 1st BYTE DATA | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | D7~D1 | Unused |
| | Unused | | | | | | | | D0 | Blanking; 1 : On ; 0 : Off |

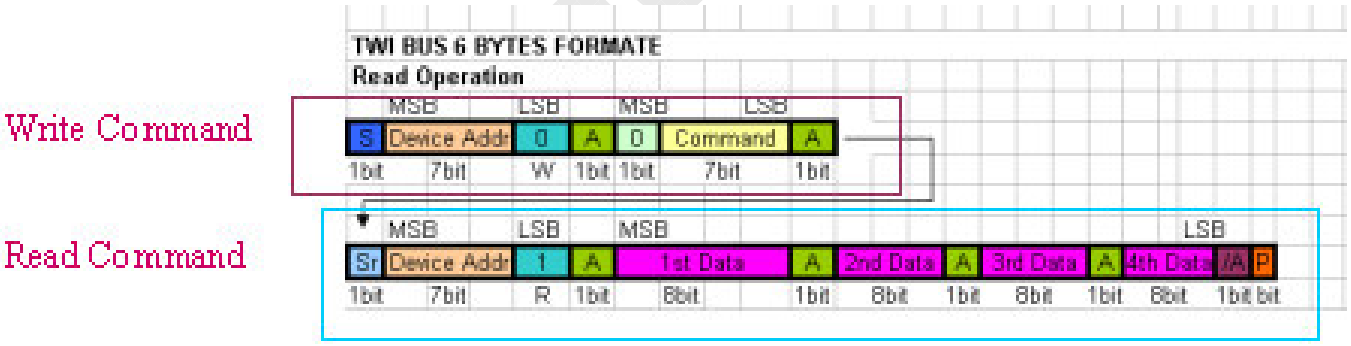
Rotation Panel Function

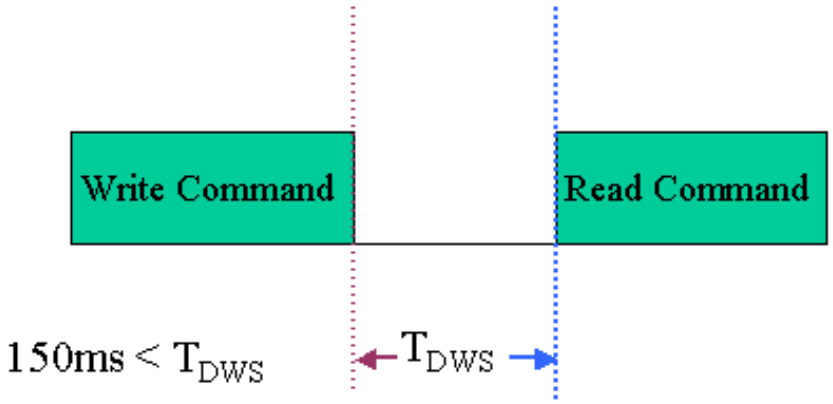
| RPF : 0x0D | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 4 Bytes Data Length | | | | | | | | | | |
| 1st BYTE DATA | D31 | D30 | D29 | D28 | D27 | D26 | D25 | D24 | D31~D26 | Unused |
| | Unused | | | | | | | | D24 | Rotation; 1 : 180° ; 0 : 0° |
| 2nd BYTE DATA | D23 | D22 | D21 | D20 | D19 | D18 | D17 | D16 | D23~D0 | Unused |
| | Unused | | | | | | | | | |
| 3rd BYTE DATA | D15 | D14 | D13 | D12 | D11 | D10 | D9 | D8 | | |
| | Unused | | | | | | | | | |
| 4th BYTE DATA | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | 0: Normal display<br>1: Rotation display | |
| | Unused | | | | | | | | | |

| RPF : 0x8D | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 Byte Data Length | | | | | | | | | | |
| 1st BYTE DATA | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | D7~D1 | Unused |
| | Unused | | | | | | | | D0 | Rotation; 1 : 180° ; 0 : 0° |

## A.6 TWO WIRE BUS REQUIREMENT

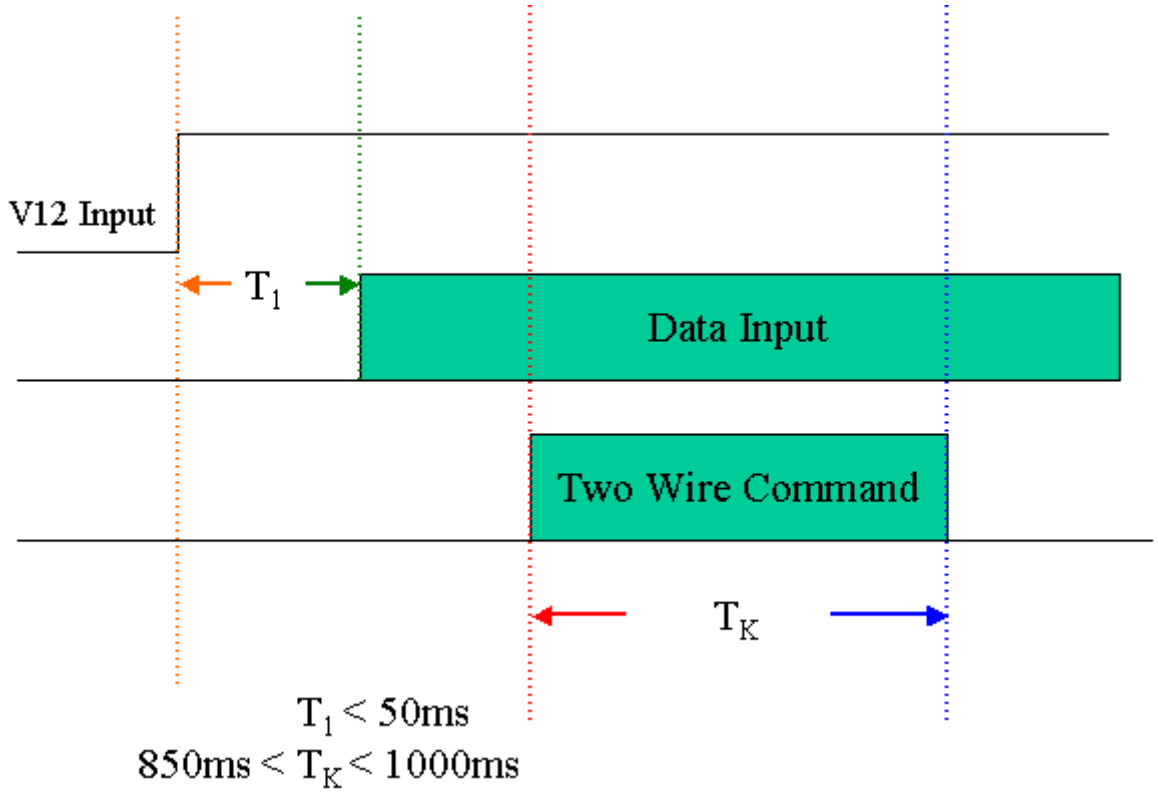
| Symbol | Parameter | Condition | Min | Max | Unit |
|---|---|---|---|---|---|
| $V_L$ | Input Low-voltage | | 0 | 0.7 | V |
| $V_H$ | Input High-voltage | | 2.7 | 3.3 | V |
| $t_r$ | Rise Time for both SDA and SCL | | $20 + 0.1C_b$ | 300 | ns |
| $t_{cf}$ | Output Fall Time from $V_{IHmin}$ to $V_{ILmax}$ | $10\ pF < C_b < 400\ pF$ | $20 + 0.1C_b$ | 250 | ns |
| $I_i$ | Input Current each I/O Pin | $0.1V_{CC} < Vi < 0.9V_{CC}$ | -10 | 10 | uA |
| $C_i$ | Capacitance for each I/O Pin | | NA | 10 | pF |
| $f_{SCL}$ | SCL Clock Frequency | | 4 | 50 | KHz |
| $R_P$ | Value of Pull-up resistor | $f_{SCL} \leqq 50KHz$ | 3000 | $1000ns/C_b$ | Ω |
| $t_{HDSTA}$ | Hold Time (repeated) STAR Condition | $f_{SCL} \leqq 50KHz$ | 4 | NA | us |
| $t_{LOW}$ | Low Period of the SCL Clock | $f_{SCL} \leqq 50KHz$ | 4.7 | NA | us |
| $t_{HIGH}$ | High Period of the SCL Clock | $f_{SCL} \leqq 50KHz$ | 4 | NA | us |
| $t_{SUSTA}$ | Set-up time for a repeated STAR Condition | $f_{SCL} \leqq 50KHz$ | 4.7 | NA | us |
| $t_{HDDAT}$ | Data hold time | $f_{SCL} \leqq 50KHz$ | 0 | 3.45 | us |
| $t_{SUDAT}$ | Data setup time | $f_{SCL} \leqq 50KHz$ | 250 | NA | ns |
| $t_{SUSTO}$ | Setup time for STOP Condition | $f_{SCL} \leqq 50KHz$ | 4 | NA | us |
| $t_{QLF}$ | Bus free time between a STOP and START Condition | $f_{SCL} \leqq 50KHz$ | 4.7 | NA | us |



A.7 THE TWO WIRE BUS SEQUENCE

I. Initial state




II. Stable state